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ABSTRACTS

Papers presented at the 72nd Annual Meeting
University of Alabama at Birmingham
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March 15-18, 1995

BIOLOGICAL SCIENCES

GROWTH RATE AND AGE DISTRIBUTION OF STERNOTHERUS MINOR AT RAINBOW RUN, MARION CO., FLORIDA. Dave Onorato, Collegium of Natural Sciences, Eckerd College, St. Petersburg, FL 33733, and Florida Marine Research Institute, St. Petersburg, FL 33701.

Between January 5, 1990 and August 27, 1992, a total of 482 Sternotherus minor were marked at Rainbow Run, Marion Co., Florida. Sex specific and size specific growth rates (plastron and carapace length) of S. minor were determined using data from a mark-release-recapture study. Growth rates decrease with increasing carapace and plastron lengths, with no significant differences in specific growth rates between males and females. Ages of all marked turtles were estimated using a von Bertalanffy growth equation calculated from the recapture data on carapace lengths. Age estimates for S. minor were then used to determine the age distribution of the population at Rainbow Run. Young S. minor of 5 years or less comprise over 65% of the population while it also appears that some of these turtles reach ages of 21 or more years.

ECTOTHERMY IN DOLPHIN DENTITION. Michelle A. Ortega-Edwards and Gerald T. Regan. Department of Biology, Spring Hill College. Mobile, AL 36608.

The dentine of dolphins has variations in optical density that are repeated annually according to Sergeant, Hui, Hohn, Fernandez, and others. To try to help explain the causes of these variations, we searched for a periarterial rete in the vascular system of the dentine-producing odontoblasts. Such retes were known to occur in the vascular system of dolphin appendages that have thin, if any, blubber and are poorly insulated. A dolphin snout also has thin or no blubber. A rete functions as a biological heat exchanger and minimizes heat loss from the appendages when the water is cold, at the same time lowering the temperature of the appendages. A similar lowering of the temperature of the snout might change the metabolism of the odontoblasts and result in variation in the dentine. We injected plaster into the aorta of a salvaged, dead Atlantic Bottlenose Dolphin (Tursiops truncatus) to verify the arterial paths to the dentary bone and to the maxilla. We cut away bone so as to gain access to the alveolar arteries and then made thick, free-hand sections of the tissues through which the arteries traveled and observed the venous patterns. In the dentary we found a circle of small veins surrounding the artery behind the posteriormost tooth. There were small veins in contact with the artery in the maxilla behind the posteriormost tooth but not in a symmetrical pattern. We conclude provisionally that there are periarterial retes in both the dentary and in the maxilla and that the snout and the teeth in it are ectothermic in the winter.

Abstracts

Feather Meal as a Replacement of Fish Meal in the Diet of Oreochromis niloticus Alevin. Charles D. Bishop, Robert A. Angus and Stephen A. Watts. Univ. of Ala. at Birmingham. Birmingham, Al. 35294.

Fish meal is the primary source of animal protein in most commercially prepared fish diets. By the year 2000, 1.5 million tons of fish meal are predicted to be required to satisfy the feed demand of the expanding aquaculture industry. Due to limitations created by over-fishing, alternative sources of animal protein have been sought. A less expensive and readily available source of animal protein can be derived from poultry feather waste. In this study 4 diets were developed in which equal weights of hydrolyzed feather meal (F) replaced equal weights of fish and meat and bone (FMB) meal in the following percentages 0/100, 33/66, 66/33 and 100/0 (F/FMB). Each diet was proffered ad libitum to 2 replicate groups of 60 alevin for 42 days. Survivorship was not significantly different among treatments (> 93 %). The individuals fed 0/100, 33/66 and 66/33 (F/FMB) did not differ significantly in median or mean weight gain, however, individuals fed 100/0 (F/FMB) were significantly smaller than all other diets at days 21 and 42. The growth of Oreochromis niloticus alevin was not compromised by replacement of up to 66% of animal protein (9.9% of the total diet) with feather meal. Feeding feather meal as a sole source of animal protein, however, appears to result in a decrease in weight gain and associated growth parameters.

FOSSIL HOLDINGS OF THE ANNISTON MUSEUM OF NATURAL HISTORY. Russell F. House and Jeri W. Higginbotham. Department of Biology, Jacksonville State University, Jacksonville, AL 36265.

Since its founding, fossils have been donated to the Anniston Museum of Natural History, so that the collection now totals over 500 specimens. Most of these fossils sat unidentified or misidentified for years. The collection has now been organized, with taxonomic, donor, origin site, and accession information assigned to each specimen. This information, initially recorded on accession sheets, is now being compiled for entry into "Accession 2.1", the museum's current accession database. Also, photographs of each specimen are being transferred onto CD ROM. Most of the fossils come from Paleozoic strata in the southeastern U.S., and include marine invertebrates, Carboniferous plants, and some Mesozoic vertebrates. The museum encourages donations, particularly of poorly represented eras and groups.

Abstracts

POSTURE AND STANCE OF *TRICERATOPS*: EVIDENCE OF DIGITIGRADE FEET AND CANTILEVER VERTEBRAL COLUMN. William R. Garstka, Dept. Biol. Sci., Univ. Ala. Huntsville, Huntsville, AL 35899. David A Burnham, Fossilworks, Rapid City, SD 57701.

Remains of *Triceratops horridus* are abundant in the late Cretaceous of western North America making this among the best known dinosaurs, yet few even partially articulated specimens are known. Further, no unequivocal trackways are known. Hence, there is much argument about skeletal reconstruction, particularly of stance. Our recent finds in the Hell-Creek Formation of North Dakota as part of a 1994 expedition organized by Warfield Fossils, Inc., shed new light on this controversy. We excavated two uniquely articulated *Triceratops* specimens. One specimen, "Willy", had a complete pelvis with 7 dorsal vertebrae articulated by means of ossified tendons and a partially articulated forelimb consisting of an ulna with three metacarpals. The second specimen, "Raymond", had a nearly complete skull, a fully articulated vertebral column extending in an "S" curve from the pelvis to the atlas/axis, the right ribcage in place, and the right shoulder and forelimb and right hindlimb complete, in place, and fully articulated. These specimens clearly indicate an upright and digitigrade stance for this dinosaur. The position of the glenoid, the curve of the coracoid, and the nearly straight anterior ribs indicate a narrow chest with upright rather than sprawling forelimbs. In the manus, digits ii, iii, and iv point anterior, digit i is rotated somewhat behind ii because of a trapezoidal metacarpal and digit v is held up and behind the others. The pes, too, has digits ii, iii, and iv oriented anterior with digit i considerably behind for an elongate foot. These positions are in agreement with tracks from the Laramie Formation of Colorado attributed by Lockley to a ceratopsian.

IDENTIFICATION OF SEVERAL TILAPIA SPECIES USING ISOELECTRIC FOCUSING OF MUSCLE PROTEINS. Mickie L. Powell and Stephen A. Watts., Dept. of Biology, Univ. of Ala. at B'ham., Birmingham, AL 35294-1170.

Identification of tilapia species currently relies on morphological, biochemical and molecular techniques. Morphological characteristics may be ambiguous and molecular techniques may be time consuming and expensive. Isoelectric focusing of total proteins is a biochemical technique which can potentially be used for species identification and is less costly in terms of both time and expense than many of the currently utilized molecular identification techniques. Samples of muscle tissue were removed from the dorsal region near the tail using a 1 mm tissue punch inserted under the scale. Water soluble proteins in the muscle samples were separated using isoelectric focusing (IEF) to identify potentially unique banding patterns. Of the *Oreochromis* species tested, *O. zilli* and *O. honorum* could easily and reproducibly be separated based on patterns of muscle proteins of various isoelectric points. *O. niloticus* and *O. aureas* were not easily distinguishable using this technique. This may be due to the close relation of the species or possibly a consequence of historical stock contamination. Other populations of these species, including species from the type location, should be examined before any final conclusions are made. The utilization of muscle biopsy followed by treatment with the antibiotic Neosporin resulted in no mortalities in the fish populations sampled. This non-evasive technique has been used successfully in populations where limited stocks are available. With further refinements, this technique may be used as a valuable identification tool.

BIOLOGICAL ACTIVITY OF SECONDARY METABOLITES FROM THE SEASTAR LUIDIA CLATHRATA. Patrick J. Bryan, James B. McClintock, Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294 and Maria Iorizzi, Luigi Minale, Department of Chemistry, University of Naples, 80131 Naples, Italy.

The feeding deterrent, antifouling and antimicrobial activities of crude extracts and pure compounds isolated from the seastar Luidia clathrata were investigated. Food pellets containing body-wall extracts at a concentration of 3.0 mg/ml agar significantly deterred feeding by the pinfish Lagodon rhomboides. The body-wall extract inhibited larval attachment of two fouling organisms, the barnacle Balanus amphitrite and the bryozoan Bugula neritina, at concentrations as low as 0.0048 mg extract/ ml seawater. All ten pure compounds tested significantly inhibited attachment of barnacle larvae at a concentration of 0.2 mg/ml seawater. A non-sulfated steroid (5 α -cholestane-3 β ,5,6 β ,15 α ,16 β ,26-hexaol) and an asterosaponin (ophydianoside F) were the most potent of the isolated compounds, inhibiting attachment of the barnacle larvae at a concentration of 0.008 mg/ml. Luidia clathrata ethanolic body-wall extract inhibited growth of the Gram-positive bacteria Bacillus subtilis and Staphylococcus aureus at a concentration of 0.75 mg per filter paper disc. Moreover, two of the ten compounds assayed, one a sulfated steroid (5 α -cholestane,3 β ,5,6 β ,15 α ,24-pentaol,15-sulfate) the other non-sulfated (5 α -cholestane-3 β ,6 β ,7 α ,15 α ,16 β ,26-hexaol), inhibited growth of both B. subtilis and S. aureus at a concentration of 50 μ g per disc. While all ten pure compounds inhibited larval attachment only two displayed antimicrobial activity. This indicates that while some polyhydroxysteroids and asterosaponins have a broad spectrum of activity, others activity may be more specific.

PROGESTERONE METABOLISM IN CELL FREE PREPARATIONS OF GONADAL AND BODY WALL TISSUES FROM THE ECHINOID LYTECHINUS VARIEGATUS. K.M. Wasson, G.A. Hines, J.B. McClintock and S.A. Watts. Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham AL35294-1170.

Towards the end of the spawning season (May), Lytechinus variegatus (ca. 50 mm test diameter) were collected from Port Saint Joseph Bay, Florida and transported to the University of Alabama at Birmingham. The gonads were excised and weighed and gender was determined by microscopic examination of gonadal smears. Testes and ovaries were each homogenized, pulse sonicated, and cellular debris was removed by centrifugation. Spines, gonadal and digestive tissue were removed from the body walls, which were then minced, pulse sonicated and centrifuged. Supernatants were incubated with ³H-progesterone for 0.5, 2, and 8 h. Rates of steroid metabolism in supernatants were estimated based upon equal tissue mass (wet weight). Aqueous-soluble metabolites accounted for less than 5 % of the total metabolites and were not further identified. Organic soluble metabolites were isolated by TLC. Rates of progesterone conversion in the gonads varied greatly among individuals and may be related to variations in the gametogenic state at the time of collection. Sex-specific differences between the testes and ovaries in the overall rates of conversion were not apparent. Initial isolation schemes indicate both ovaries and testes produced at least four metabolites; one of the prominent metabolites was 5 α -reduced progesterone. In the body wall supernatant, rates of conversion of progesterone were ca. 15% of that observed in the gonads. Sex-specific differences were not observed and at least two unidentified metabolites not seen in the gonads were isolated. This is the first report of progesterone metabolism in any echinoid. Supported by NSF EHR-9108767.

Abstracts

The Role of PI-3 Kinase in Neurite Outgrowth in hNT Neurons. Christina R. Burga, Latanya Hammonds-Odie, Ira Blader, and Anne Theibert, Neurobiol. Res. Ctr. and Dept. of Cell Biol., Univ. of AL at B'ham, Birmingham, AL 35294.

Phosphoinositide 3-kinase (PI 3-kinase) is an enzyme that transfers a phosphate group from ATP to the membrane phospholipids phosphatidyl inositol (PtdIns) and phosphatidylinositol 4,5-bisphosphate (PtdIns-4,5-P₂). Phosphorylation of the phospholipid occurs at the 3-hydroxyl on the inositol head group and the products are PtdIns-3-P and PtdIns-3,4,5-P₃. Recently, this PI 3-kinase and its product PtdIns-3,4,5-P₃ have been intensively studied because of their possible roles as messengers in cell growth and differentiation. Hormones, growth factors, cytokines, and neurotrophic factors activate PI 3-kinase and stimulate the production of PtdIns-3,4,5-P₃ very rapidly after binding to their receptors. Our laboratory is focused on identifying the role of the PI 3-kinase and its product PtdIns-3,4,5-P₃ in neurons.

In the past, our lab has examined the pheochromocytoma PC12 cells and has demonstrated that PI 3-Kinase is required for neurite outgrowth and maintenance. We are now examining a cell line derived from a human tetracarcinoma, NT2, which exhibit properties characteristic of a committed neuronal precursor at an early stage in development. NT2 cells can be induced by retinoic acid to differentiate (in culture) into postmitotic CNS neurons, hNT neurons. These neuronal like cells express many neuronal markers and produce processes that can be identified as axons or dendrites. Both of these cells, the precursor NT2 and the differentiated hNT, can be transfected with exogenous DNA. Using combined biochemical, immunocytochemical, and molecular biological approaches we will ask the following questions. Do NT2 cells express PI 3-Kinase? Do levels change upon differentiation? Is PI 3-Kinase present in axons or dendrites and is it required for the outgrowth and maintenance of these processes?

EARLY RECRUITMENT STUDIES OF THE REGULAR URCHIN LYTECHINUS VARIEGATUS IN DIFFERENT BENTHIC HABITATS. Noel B. Leonard, J.B. McClintock, K.R. Marion, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294, and J.M. Lawrence, Dept. of Biology, Univ. of South Florida, Tampa, FL 33620.

Little is known concerning major aspects of early recruitment in populations of echinoderms. This investigation is designed to determine whether early recruitment in the regular urchin Lytechinus variegatus varies with regard to season and habitat type. Three benthic habitats defined by the presence of major vegetation type have been identified at St. Joseph's Bay, Florida. Larval densities are determined monthly at each habitat using plankton tows. New recruitment is quantified monthly by counting the newly metamorphosed urchins present on triplicate settlement mats placed at each habitat site. Each natural habitat is additionally sampled quarterly, and the number of new recruits counted for comparison in order to confirm the reliability of the settlement mat collecting technique. Early data show no echinoplutei larvae present in the water column during fall 1994 and winter 1995, nor has any significant recruitment occurred. These two observations are consistent with our hypothesis that the major recruitment period will occur in spring.

Abstracts

Indigenous Bacteria: Potential Usefulness in Diesel Fuel Bioremediation. Victoria J. McConnell, Ronald B. Young, Dept. of Biolog. Sci., Univ. of AL at Huntsville, Huntsville, AL 35899. Linda Harris-Young and Lisa M. Haywood, Emerg. Resp. Specialists, Birmingham, AL 35116

Bioremediation is a process in which microorganisms are used to degrade chemical contaminants. Bioaugmentation involves the use of commercially purchased bacterial populations, whereas biostimulation involves resuscitation of indigenous bacteria through the use of fertilizers. A commercial preparation of the bacterium, *Alcaligenes faecalis*, was applied to an accidental gasoline spill-site. Limiting nutrients (e.g., nitrogen, phosphorous) were also added. Based upon biochemical and morphological differences, predominating colony-types (*Pseudomonas* sp., *Achromobacter* sp., *Agrobacterium* sp., *Flavobacterium* sp., *Moraxella* sp.) were identified from soil samples over a period of 30 days. Because of the lack of information on the survival of bacteria in high concentrations of petroleum, indigenous bacterial isolates were evaluated for their potential to survive in high concentrations of diesel fuel. The non-indigenous bacterium, *A. faecalis*, was not recovered from any of the soil samples. All indigenous bacterial isolates survived 100% diesel fuel concentration, but one in particular had a 10-fold increased colony count. These experiments indicate that biostimulation may be more efficient and less expensive than bioaugmentation.

ALLOZYME VARIATION IN THE ALABAMA REDBELLY TURTLE (PSEUDEMYS ALABAMENSIS). Briana C. Patterson and Terry D. Schwaner, Alabama School of Mathematics and Science, Mobile, AL 36604. David E. Nelson and Jarrod Forgarty, Dept. of Biological Sciences, Univ. of S. Ala., Mobile, AL 36688.

Allozyme electrophoresis was used to estimate genetic variation in the Alabama redbelly turtle, a threatened species with a single known population inhabiting the upper Mobile Bay drainage. Analysis of blood samples from 17 individuals for 16 presumed gene loci representing one non-enzymatic and 13 enzymatic proteins revealed polymorphisms at five loci (ALB, PEP A, PEP D, GPI, CA2). The following loci appeared to be monomorphic: IDH, LDH, MPI, AAT, PGM, PEP B, 6PGD, MDH1, MDH2, UAE, CA1. Blood samples were taken and similarly analyzed for eight individuals of the black-knobbed map turtle (Graptemys nigrinoda), an abundant, widespread species in the Alabama-Tombigbee-Black Warrior River systems. One individual was polymorphic for the PEP D locus; otherwise, the remaining loci were found to be monomorphic for all individuals. Sample sizes and numbers of loci examined notwithstanding, a more restricted and much less abundant population of redbelly turtles seemed to have more genetic variation than the more widespread and abundant map turtles.

Abstracts

DEVELOPMENTAL CHANGES IN VITELLIN-IMMUNOREACTIVE PROTEINS IN THE HEMOLYMPH AND TISSUES OF THE BLUE CRAB, *CALLINECTES SAPIDUS*. Heidi R. Umphrey, C.-Y. Lee, and R.D. Watson, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

Previous studies of female blue crabs (*Callinectes sapidus*) have demonstrated that the ovary (but not the hepatopancreas) synthesizes vitellin (Vn) *in vitro*. To further test the hypothesis of extraovarian synthesis of Vn, immunocytochemistry and enzyme-linked immunosorbent assay (ELISA) were performed on hemolymph and tissues of crabs in various stages of ovarian development. Crabs were staged according to oocyte diameter. Immunocytochemical studies showed that Vn-immunoreactive proteins were absent in ovarian tissues at stages I (oocyte diameter: 16-24 μ m), and II (30-60 μ m), and were present at stages III (66-100 μ m), IV (103-160 μ m), V (168-288 μ m), and VI (86-127 μ m); the hepatopancreas and muscle were not immunoreactive at any stage. ELISA revealed no Vn-immunoreactive proteins in hemolymph of crabs from stages I and II. Vn-immunoreactive proteins were detectable in the hemolymph of some animals of stages III, IV, V, and VI (post spawning). The average concentration of Vn-immunoreactive proteins for these stages was 0.02 ± 0.01 , 0.02 ± 0.04 , 0.12 ± 0.15 mg/ml, and 0.14 ± 0.04 respectively; the percentages of crabs with detectable hemolymph Vn-immunoreactivity were 16.67 (stage III), 31.58 (stage IV), 72.73 (stage V), and 100 (stage VI). The low-level of Vn-immunoreactive proteins in hemolymph and the low percentage of hemolymph samples which contained detectable Vn-immunoreactive proteins are not consistent with the hypothesis that Vn-immunoreactive proteins are synthesized extraovarially, released into the hemolymph, and subsequently sequestered by vitellogenic oocytes. These data and data from previous *in vitro* experiments suggest that the ovary is the exclusive site of Vn synthesis in the blue crab. Supported by MS/AL Sea Grant NA16RGO155-30.

RAT SUBMANDIBULAR GLAND (SG) EGF CONTENT IS MODULATED BY STEROID HORMONES. Katherine A. Mousel, P. S. Campbell, and D. M. Moriarity, Department of Biological Sciences, The University of Alabama in Huntsville, AL 35899.

Although the female rat exhibits a cyclic pattern of alteration in SG EGF in which EGF is highest during estrus, the adult female rat has lower SG EGF content than the male. However, gonadectomy of young adult male or female Sprague-Dawley rats abolishes this sex difference. Chronic treatment (pellet implantation) of male or female rats with testosterone or estradiol produces higher SG EGF levels than that observed in the neutered controls. The increase in EGF content tended to be greater in rats implanted with estradiol rather than testosterone pellets. Furthermore, the male SG appears to be more responsive to hormonal stimulation of EGF content. The gender difference in endogenous SG EGF content, then, might be a consequence of the pattern of sex steroid hormone secretion rather than the particular type of hormone secreted. Indeed, implanting low dose, 21 day release estradiol pellets into prepubertal rats (21 days or 35 days of age) impairs the normal postpubertal development of male-pattern SG EGF content.

Abstracts

GLUCOSE CONVERSION TO GLUCOSAMINE IS REQUIRED FOR GLUCOSE STIMULATION OF TRANSFORMING GROWTH FACTOR- α GENE TRANSCRIPTION. Peter P. Sayeski and Jeffrey E. Kudlow M.D., Department of Medicine, UAB, Birmingham, AL 35294

The transcription of the transforming growth factor- α (TGF α) gene in arterial vascular smooth muscle cells can be increased by exposure to supra-physiological concentrations of glucose. Glucosamine (GlcN) can mimic this effect of glucose, but at lower concentrations and with a greater effect on the transcription rate and mRNA accumulation. To determine whether metabolism of glucose to GlcN is required for the glucose effect, we studied glucoregulation of TGF α expression under conditions where the rate limiting step in glucose metabolism to GlcN, through the enzyme glutamine:fructose-6-phosphate amidotransferase (GFAT) was blocked. The glucose affect was measured by transiently transfecting primary rat aortic smooth muscle cells with the TGF α promoter linked to a firefly luciferase reporter. In this system, glucose reliably stimulated reporter function 2- to 4-fold. Using the glutamine analog, 6-diazo-5-oxonorleucine (DON), which covalently modifies and inactivates GFAT, the glucose effect on TGF α driven reporter function was completely blocked. However, this blockage of GFAT could be bypassed by GlcN. Since DON could alter other glutamine utilizing pathways, we used an antisense RNA approach in which we expressed extremely high levels of mouse GFAT mRNA in the antisense orientation by placing the antisense GFAT cDNA under the control of the HIV-1 LTR. Antisense expression was increased a further 1000-fold by cotransfecting the gene encoding HIV-1 tat. Under these conditions, we demonstrated that antisense mediated blockage of GFAT expression resulted in cells with a significantly blunted ability to increase TGF α expression in response to glucose. To assess whether ambient glucose concentrations could alter the O-glycosylation of cytoplasmic and nuclear proteins, we performed western blots using a monoclonal antibody that recognizes O-linked N-acetylglucosamine (O-GlcNAc) on proteins. Glucose and GlcN increased this modification in several proteins. Furthermore, DON blocked the glucose, but not glucosamine stimulated increase in O-GlcNAc protein modification. These results strongly indicate that, of all the pathways of glucose metabolism, it is the pathway to glucosamine that is necessary for the transcriptional stimulation of the TGF α expression in vascular smooth muscle cells by glucose. These results have important implications with regard to the pathogenesis of diabetes vascular complications.

MOLECULAR EPIDEMIOLOGY OF *STREPTOCOCCUS PNEUMONIAE*. A. Brooks-Walter, S.K. Hollingshead, L.S. McDaniel, D.E. Briles. Department of Microbiology, University of Alabama at Birmingham.

S. pneumoniae is a primary cause of bacterial pneumonia, bacterial meningitis and otitis media. Prior studies have shown that pneumococci can be highly diverse even within capsular type, and therefore it has become important to study the epidemiology and genotypic background of strains. *PspA*, a virulence factor found on all pneumococcal isolates, has a high degree of antigenic inter-strain variation. The deduced amino acid sequence of *PspA* predicts three distinct domains; an α -helical coiled-coil region, followed by two adjacent proline-rich regions, and ten 20 amino acid repeats. Oligonucleotide primers based on the sequence of *pspA* from *S. pneumoniae* Rx1 were used to amplify full-length *pspA*, the N-terminal region including the α -helical and the proline-rich region, and the C-terminal region including the proline-rich and the repeat region. PCR-amplified products were digested with *Hha* I or *Sau*3A I to visualize restriction fragment length polymorphisms (RFLP) of *pspA* and assess the variability within each region of the molecule. Isolates with the same capsular type and isolated from the same geographic region during a pneumococcal outbreak exhibited similar banding patterns. The RFLP patterns obtained from random strains were not completely unique. Some seemingly unrelated strains contained identical or similar RFLP patterns. Our data suggest that this method in combination with other techniques can be useful for studying of the clonality of pneumococcal isolates. Because the RFLP pattern is based on common restriction sites, two strains with identical RFLP patterns of *pspA* do not necessarily have identical *PspA*'s.

Abstracts

MORPHOMETRIC AND MOLECULAR DISCRIMINATION STUDIES OF CRICKET FROG SPECIES: METHODS FOR DETECTION OF POTENTIAL HYBRIDIZATION. Debra S. Moore and Ken R. Marion, Department of Biology, University of Alabama at Birmingham, and Scott F. Michael, Department of Microbiology, University of Alabama at Birmingham, UAB Station, Birmingham, AL 35294

Identification and separation of closely-related species have traditionally been performed utilizing standard morphometric and meristic analyses. For frogs of the genus Acris these analyses have historically included such factors as the number of anal warts, the length of the hind legs, the pointedness of the head, the quality of the post-femoral stripe, and the webbing of the hind foot. These indicators have not proven to be adequate for consistent separation of the two cricket frog species, A. crepitans and A. gryllus. Discrimination between the species is further complicated by the possibility of hybridization. Morphologically indistinct individuals have been found that can not be placed in either species using the standard methods. A more definitive method for identification is the use of polymerase chain reaction (PCR) to allow direct comparison of a portion of the mitochondrial DNA of individual specimens. Part of the Acris cytochrome B gene has been cloned to provide specific primers for use in PCR. This is significant because primers developed for the closely-related genus Hyla have not given good results, nor have conserved primers designed for use with any vertebrate. With these specific primers, the cytochrome B sequence for each Acris species can be determined. Comparison of the molecular analysis to the morphometric data will allow a determination of the extent of hybridization between the two species.

SCANNING ELECTRON MICROSCOPIC INVESTIGATION OF TORUS-BEARING PIT MEMBRANES IN THE WOODY FERN *BOTRYCHUM DISSECTUM*. Angela C. Morrow and Roland R. Dute, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849.

Our prior work on *Botrychium dissectum* focused on using transmission electron microscopy to trace torus development in the pit membrane. Currently, we are supplementing our TEM studies with scanning electron microscopy. The pit membrane consists of microfibrils which range in thickness from 0.01 μm to 0.07 μm from one pit membrane to another. Within any given pit membrane the microfibrils can differ from one another in thickness from 0.03 μm to 0.05 μm . An explanation for some of the variation in microfibril size might be a coating of the fibrils due to a wound response. The pit membrane is composed of multiple layers of microfibrils which can have different orientations. The pit membrane in some instances is differentiated into a thickened torus and a margo. In such cases the margo has an open weave of microfibrils, whereas the torus has a very tight weave. The mean diameter of the torus is 3.89 μm , and the mean diameter of the pit aperture is 2.22 μm . We hypothesize that the torus is of sufficient diameter to occlude the pit aperture in the event of the displacement of the pit membrane during introduction of an air embolism. This research was funded by a grant from the Alabama Academy of Science.

Abstracts

GENERATION OF VIABLE BUT NON-CULTURABLE STATE IN *Salmonella typhimurium*. Wee-Yao Ng and Asim K. Bej, Dept. Of Biology, University of Alabama at Birmingham, UAB Station, AL 35294-1170.

Various species of bacteria such as *Escherichia coli*, *Vibrio vulnificus*, *Vibrio cholerae* and *Legionella pneumophila* have been demonstrated to enter into a viable but non-culturable (VBNC) state. In this study, the ability of *Salmonella typhimurium* ATCC 13311 to lose its culturability on agar media but maintain its viability was investigated. *S. typhimurium* 13311 was grown in Luria Bertani (LB) broth to the mid-logarithmic phase ($OD_{450}=0.8$). The cells were harvested and incubated in sterile Cahaba River water that had been aged for 30 days at 5°C with agitation at 50 rpm. The culturability of the cells was monitored by plating on LB agar. The viability of the cells was monitored using the Kogure Direct Viable Count (DVC) method and the LIVE/DEAD BacLight Viability Kit. The cells failed to lose its culturability and maintained a population of over 10^4 culturable cells over a period of 2 months. The failure of the *S. typhimurium* to enter into the VBNC state could possibly be due to the presence of leftover nutrients on the glassware and cell walls. Thus, all traces of nutrients were removed from all glassware used by acid washing with a dichromate sulfuric acid solution followed by 6N hydrochloric acid. Traces of nutrients on the bacterial cell walls were removed by resuspending of harvested cells in 5% LB broth followed by 1% LB broth. Lastly, the cells were washed twice with sterile Cahaba River water. The nutrient free cells were then incubated in sterile Cahaba River water using nutrient free flasks at 5°C with agitation at 50 rpm. After 30 days incubation, no cells were cultured from the microcosms. However, viable cells were detected by the Kogure DVC method and the LIVE/DEAD BacLight Viability Kit. Therefore, the usage of appropriately treated nutrient free glassware and cells was effective in the generation of VBNC state in *S. typhimurium* 13311. The persistence of pathogenicity and other physiological functions in the VBNC state is currently being investigated.

CHARACTERIZING VIABILITY IN THE EMBRYONIC CHICK PANCREAS USING IMMUNOFLUORESCENCE TECHNIQUES. Connie Meacham, Nina German, Kim Allison, and Adriel Johnson. Department of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL 35899

Viability of an embryonic chick pancreatic culture system was characterized using immunofluorescence techniques. The whole pancreas from 18 day-old embryonic chicks were cultured for 2 to 48 hours. Culture media was collected for enzymatic assay of lactate dehydrogenase and amylase. The pancreas was fixed in cold ethanol, dehydrated, and embedded in paraffin. Tissue was sectioned (7 μ), and examined using fluorescence microscopy while still embedded in paraffin. Tissue was then deparaffinized, and immunostained for amylase (rabbit anti-amylase, followed by goat anti-rabbit IgG conjugated to rhodamine). Both positive and negative controls were included. For comparison, tissue was also stained by conventional methods using hematoxylin and eosin. The pattern of fluorescence, as an indication of viability over incubation time, was in agreement with functional studies of enzyme release, and conventional histology. Autofluorescence pattern profiles revealed morphological integrity up to 8 hours of culture, with observed degenerative changes occurring after 12 hours. These data correspond well with previous secretory studies, indicating that this culture system is functional for short-term incubations.

Abstracts

DEVELOPMENTAL CHANGES IN VITELLIN-IMMUNOREACTIVE PROTEINS IN THE HEMOLYMPH AND TISSUES OF THE BLUE CRAB, *CALLINECTES SAPIDUS*. Heidi R. Umphrey, C.-Y. Lee, and R.D. Watson, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

Previous studies of female blue crabs (*Callinectes sapidus*) have demonstrated that the ovary (but not the hepatopancreas) synthesizes vitellin (Vn) *in vitro*. To further test the hypothesis of extraovarian synthesis of Vn, immunocytochemistry and enzyme-linked immunosorbent assay (ELISA) were performed on hemolymph and tissues of crabs in various stages of ovarian development. Crabs were staged according to oocyte diameter. Immunocytochemical studies showed that Vn-immunoreactive proteins were absent in ovarian tissues at stages I (oocyte diameter: 16-24 μ m), and II (30-60 μ m), and were present at stages III (66-100 μ m), IV (103-160 μ m), V (168-288 μ m), and VI (86-127 μ m); the hepatopancreas and muscle were not immunoreactive at any stage. ELISA revealed no Vn-immunoreactive proteins in hemolymph of crabs from stages I and II. Vn-immunoreactive proteins were detectable in the hemolymph of some animals of stages III, IV, V, and VI (post spawning). The average concentration of Vn-immunoreactive proteins for these stages was 0.02 ± 0.01 , 0.02 ± 0.04 , 0.12 ± 0.15 mg/ml, and 0.14 ± 0.04 respectively; the percentages of crabs with detectable hemolymph Vn-immunoreactivity were 16.67 (stage III), 31.58 (stage IV), 66.66 (stage V), and 47.37 (stage VI). The low-level of Vn-immunoreactive proteins in hemolymph and the low percentage of hemolymph samples which contained detectable Vn-immunoreactive proteins are not consistent with the hypothesis that Vn-immunoreactive proteins are synthesized extraovarially, released into the hemolymph, and subsequently sequestered by vitellogenic oocytes. These data and data from previous *in vitro* experiments suggest that the ovary is the exclusive site of Vn synthesis in the blue crab. Supported by MS/AL Sea Grant NA16RGO155-30.

TRUNCATED *S. PNEUMONIAE* PspA MOLECULES ELICIT PROTECTIVE IMMUNITY AGAINST FATAL PNEUMOCOCCAL CHALLENGE IN MICE. Rebecca Creech Tart, Larry S. McDaniel, and David E. Briles, Bacterial Pathogenesis Laboratory, University of Alabama at Birmingham, Birmingham, AL 35294-2170.

S. pneumoniae strain Rx1 is avirulent, yet PspA from this strain cross-protects mice against a large percentage of pneumococci and truncated Rx1 PspA elicits protection against 70% of strains analyzed to date (unpublished data). Capsular type 4 and 5 strains represent a subset of pneumococci that are more difficult to protect against in the mouse sepsis model. Therefore in this study, truncated *pspA* genes from strains possessing type 4 or 5 capsules were amplified, cloned, expressed, and the recombinant PspA proteins evaluated for their ability to protect mice against subsequent *S. pneumoniae* infection. Truncated PspA proteins were induced in *Escherichia coli* and cell lysates were used to immunize mice. Control animals were sham immunized with lysates from a strain containing the cloning vector alone. Next, mice were challenged with capsule type 4 or 5 parental *S. pneumoniae* strains and with type 3, 6A, and 6B strains. Immunization with the truncated PspAs protected mice against fatal challenge with capsular type 3 strains and extended time to death with type 6A and 6B strains. The three recombinant PspAs failed to offer significant protection against challenge with their respective parental strains. These data demonstrate that truncated PspAs from capsular type 4 and 5 strains elicit protection against types 3, 6A, and 6B *S. pneumoniae* but not types 4 and 5. Future studies will seek to determine if full-length PspA is a more efficient immunogen against pneumococci possessing type 4 or 5 capsules.

Abstracts

RESPONSE OF PHOTOSYNTHESIS TO LIGHT AND CARBON DIOXIDE IN SWEETPOTATOES GROWN HYDROPONICALLY AT DIFFERENT CARBON DIOXIDE CONCENTRATION. Anita P. Terse, Douglas R. Hileman, Desmond G. Mortley and Jill Hill, Dept. of Biology and Dept. of Agricultural Sciences, Tuskegee Univ., Tuskegee, AL 36088.

Sweetpotato [*Ipomoea batatas* L.(Lam)] has been selected by NASA as a food for long-term space missions because of its nutritional value, versatility and growth habit. Light and CO₂ response curves were determined for 'TI-155' and 'Georgia-Jet' sweetpotatoes grown hydroponically in growth chambers at three different CO₂ concentrations (400, 750, and 1000 $\mu\text{mol mol}^{-1}$ CO₂). Gas exchange measurements were made using infrared gas analysis, an open-flow gas exchange system and a controlled-climate cuvette. Light was supplied by the growth chamber bulbs and by four slide projector bulbs attached to the leaf cuvette. Photosynthetic measurements were made at light intensities from 0-1400 $\mu\text{mol m}^{-2} \text{s}^{-1}$ and CO₂ concentrations from 50-1000 $\mu\text{mol mol}^{-1}$ CO₂. Light saturation occurred at approximately 600 $\mu\text{mol m}^{-2} \text{s}^{-1}$. There was no significant difference in the light-saturated net photosynthetic rates of sweetpotato leaves due to CO₂ enrichment when the measurement CO₂ concentration was equal to the growth CO₂ concentration. Net photosynthetic rates from the CO₂ response curves showed an increase in photosynthetic rates with increasing measurement CO₂ but a stronger decrease in photosynthetic rates with increasing growth CO₂. The relatively stronger effect of growth CO₂ on photosynthesis may be due to a limitation in the nitrogen supply. The results of this study will help to determine the light and CO₂ requirement for growth of sweetpotato in the proposed space station.

STRUCTURE-BASED DRUG DESIGN: INHIBITORS OF PURINE NUCLEOSIDE PHOSPHORYLASE. John A. Montgomery, BioCryst Pharmaceuticals, Inc., 2190 Parkway Lake Drive, Birmingham, AL 35244

Since a genetic deficiency of purine nucleoside phosphorylase (PNP) has been associated with severe impairment of T-cell (but not B-cell) immunity, inhibitors of PNP may be T-cell selective immunosuppressive agents with potential utility in the treatment of T-cell leukemias and autoimmune disorders such as rheumatoid arthritis, and in the prevention of bone marrow or organ transplant rejection. Because of the high levels of PNP in humans, an inhibitor with a K_i of around 1-10 nM (K_m of inosine 30-35 μM) will probably be necessary to mimic the PNP deficiency needed to affect the immune system significantly. We have used the three-dimensional structure of human erythrocytic PNP as determined by X-ray crystallography to design potent inhibitors of this enzyme. The methodology employed utilizes the X-ray data on the native enzyme and on enzyme-inhibitor complexes, computer modeling of the enzyme active site and of the enzyme-inhibitor complexes, and organic synthesis, in an iterative process. Candidate inhibitors were designed by a team of crystallographers, molecular modelers, and synthetic organic chemists. Proposed compounds were then screened by modeling the enzyme-inhibitor complexes. Candidates with good steric and chemical fit to the active site were then synthesized and their IC₅₀'s determined. The actual structures of a number of the enzyme-inhibitor complexes were then determined by X-ray analysis and related to the IC₅₀'s and to the models. This approach has allowed us to prepare a number of potent inhibitors with IC₅₀'s in the 6-30 nM range. From these, BCX-34 (9-(3-pyridyl)-9-deazaguanine) was chosen for clinical trials. A topical formulation of this drug has shown efficacy and safety in Phase II studies for the treatment of cutaneous T-cell lymphoma and psoriasis.

Abstracts

The effect of exposure to chronic low doses of estrogen on the development of the male reproductive system: a model for environmental estrogenicity. Marilyn Wyatt, K. A. Mousel, and P. S. Campbell, Department of Biological Sciences, The University of Alabama in Huntsville, Huntsville, AL 35899.

Sprague-Dawley rats were subcutaneously implanted at different stages of development with 21 day continuous release hormone pellets containing a total dose of 25 μ g estradiol-17 β . Implants were placed on day 3 (neonate), day 10 (infant), day 21 ("childhood"), or day 35 ("adolescent") of life. A blood sample was obtained by cardiac puncture under ether anesthesia one week after exhaustion of the pellet for later testosterone analysis. Reproductive tissues, adrenal glands, and anterior pituitary were also excised and weighed. Testes were fixed in buffered formalin for later histological observation. One testis from each adult rat autopsied was immediately macerated in saline to prepare a wet-mount for detecting the presence or absence of sperm. One group of rats that was implanted with estradiol pellets on day 3 of life was carried to ~120 days of life before obtaining blood and tissue for analysis. Estrogen exposure resulted in reduced testes weight, smaller sex accessory tissues, and lower serum testosterone titers. In postpubertal rats, there was an absence of spermatogenesis. Ano-genital distance and penile shaft length also tended to be shorter in the estradiol-treated rats. Decreased body weight and increased adrenal gland weight in the estrogen-implanted males mimic the normal gender difference in these parameters. Hence, estrogen exposure during prepubertal development has a deleterious effect upon normal development of the male reproductive system. Exposure to estrogen during the neonatal and late prepubertal periods appear especially disruptive. Thus, it is conceivable that environmental estrogen exposure could impact human reproduction.

EFFECTS OF CHOLINERGIC AGENTS ON SECRETION USING A RAT PANCREATIC CELL DISPERSION SYSTEM. Nina S. German, Connie A. Meacham, and Adriel D. Johnson. Dept. of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL 35899.

This study was undertaken to examine the effects of selected cholinergic agents on exocrine pancreatic function using an *in vitro* rat cell dispersion system. Pancreatic acinar cells were isolated from juvenile rats fed *ad libitum* or fasted for 24 hours, using a collagenase digestion technique for cell dispersion. Acini, isolated from either fed or fasted animals, were incubated at 37°C for 60 minutes with two cholinergic agonists, carbamylcholine chloride (carbachol) or bethanechol chloride, over the concentration range of 10^{-4} M to 10^{-10} M. Media from cultures incubated were collected and spectrophotometrically analyzed for amylase activity. Preliminary data indicated both agonists increased ($p < .05$) amylase release when compared to controls. Amylase release from bethanechol-treated cultures from starved animals was higher ($p < .05$) when compared to those of the fed animals. The average percent increase stimulation over the range of bethanechol treatments for the starved and fed animals was 114% and 26%, respectively. This cell dispersion system may be used to test various cholinergic agents involved in the regulatory mechanisms of pancreatic function.

Abstracts

CONSUMPTION, DIGESTIBILITY AND ABSORPTION OF A FORMULATED DIET BY THE CRAYFISH CHERAX QUADRICARINATUS. Jennifer L. Kreider, John R. Floyd, Mark E. Meade, Stephen A. Watts, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

The Australian crayfish, Cherax quadricarinatus, has recently been imported into the United States as a potential culture species. As some life history stages may require the use of indoor hatcheries in some regions, the use of formulated diets may be required. However, little information exists concerning the dietary and nutritional requirements of any crayfish species. In this study consumption, digestibility and absorption were examined in the Australian freshwater crayfish C. quadricarinatus. Eight adult crayfish of mixed sex (mean wet weight 51.9 ± 8.8 SD) were held individually in 6l aquaria, and fed a pre-weighed formulated diet ad libitum for 35 days. Uneaten food and feces were collected each day. Water was exchanged every other day to ensure water quality. Mean consumption was $0.8\% \pm 0.1$ SD (dry food wt./wet body wt./day) or $5.1\% \pm 0.8$ SD (wet food wt./wet body wt./day). Apparent dry matter digestibility (relative percentage of dry matter consumed vs. dry matter excreted) was $99.4\% \pm 0.2$ SD. Absorption of proximate dietary constituents was calculated by comparing differences in levels of protein, lipid and carbohydrate between proffered food and feces. Total absorption of each of these constituents was greater than 98%. This is the first report of dietary parameters associated with feeding of formulated diets for the crayfish C. quadricarinatus. This research supported in part by AUTRC.

A PRELIMINARY SURVEY OF MARINE SAND TARDIGRADES OF DAUPHIN ISLAND, ALABAMA. Michael S. Gaugler and Dr. F. A. Romano. Jacksonville State University, Jacksonville, AL 36265.

In this preliminary survey, 80 samples were collected from a high energy and a low energy beach located on Dauphin Island, Alabama during the summer 1994. From the samples collected, six interstitial tardigrades were discovered in a single sample from the low energy beach. Each specimen was preserved and then mounted in Hoyer's medium. Five specimens were identified as belonging to class Heterotardigrada, order Arthrotardigrada, family Batillipidae, genus, *Batillipes*, and specific epithet *mirus*. Identification was based upon the following morphological characteristics: presence of toe pads, and the presence of caudal appendages including the number of spikes. Two of the specimens, though, possessed morphological variations of their leg spines that suggest that they might be a different species of *Batillipes*. Further studies are necessary to confirm these suspicions. The sixth tardigrade possessed different caudal appendage structures and leg spines and its identity could not be confirmed from available taxonomic keys. Thus, it is believed to be a new species and confirmation is anticipated from Drs. Diane Nelson, East Tennessee State University, and L. W. Pollock, Drew University.

Abstracts

A PRELIMINARY BIOTIC SURVEY AND WATER QUALITY ANALYSIS OF JACKSON CREEK, ALABAMA. Rebecca A. Balcomb and K. Joy Parton, Dr. F. A. Romano and Dr. R. D. Whetstone, Jacksonville State University, Jacksonville, AL 36265.

A survey of Jackson Creek was conducted from September-December 1994. This study was performed in order to deter the water quality of Jackson Creek, a major tributary of Choccolocco Creek. Jackson Creek flows through Calhoun and Cleburne counties and is part of the Coosa River drainage. Four study sites were chosen along the creek: 1) headwaters; 2) a major tributary of Jackson Creek; 3) a point midway between the headwaters and the mouth; and 4) the confluence of Jackson and Choccolocco creeks. The following studies were undertake to determine the water quality of Jackson Creek: benthic marco invertebrate and water chemistry (HACH kits). The results indicate that Jackson Creek to be in fair-good condition. Ammonia and nitrates were present at the mouth of the creek in quantities too high for the HACH kit tests this shows evidence of contamination. We believe is due (in part) to turf farms located along Jackson and Choccolocco. Microbial tests were also conducted. Fecal coliforms, staph, and strep organisms were found at each of the four test sites. The total bacteria count (TBC) for each site was as follows: 1) headwaters 95.5, 2) tributary 109.5, 3) midway 84.5, and 4) mouth 180. A fluorescence test was also performed. Twenty-four hours after inoculation this showed positive results which confirm the results of the TBC. From the results of the microbial test, the creek was determined to be in poor-fair condition.

MITOCHONDRIAL SULFIDE OXIDATION IN GILLS OF THE MUSSEL QUEKENSIA DEMISSA. Raymond W. Lee, David W. Kraus, and Jeannette E. Doeller, Dept. of Biology, UAB, Birmingham, AL 35294.

Hydrogen sulfide, a potent inhibitor of aerobic respiration, is a common constituent of coastal marine sediments, and organisms inhabiting high-sulfide muds may have mechanisms to garner cellular energy from sulfide oxidation. High sulfide is present in Spartina grass beds inhabited by Guekensia demissa. In excised gills from freshly collected G. demissa, oxygen consumption, measured with closed-chamber respirometry, was stimulated nearly 3-fold by 200-500 μM sulfide and remained stimulated at 1 mM sulfide. In contrast, in excised gills from G. demissa maintained in aerated seawater for 1-2 months prior to experimentation, oxygen consumption was stimulated less than 2-fold by 200 μM sulfide and was inhibited by 0.5-1 mM sulfide. In excised gills from Mytilus galloprovincialis freshly collected from off-shore oil platforms, oxygen consumption was inhibited by 200 μM sulfide. These results indicate that sulfide stimulation of oxygen consumption may be a function of sulfide exposure in the environment. Nearly 50% of G. demissa gill sulfide-stimulated oxygen consumption was inhibited by the mitochondrial cytochrome oxidase inhibitor cyanide. Similar results were observed in the presence of thenoyltrifluoroacetone (TTFA), an inhibitor of mitochondrial complex II, and rotenone, an inhibitor of NADH oxidation. Additional results from experiments involving coupled mitochondria isolated from G. demissa gills indicate that mitochondrial oxidation of sulfide does occur and that this oxidation may result in the production of ATP. Supported in part by NSF IBN9219658.

Abstracts

A PRELIMINARY ANALYSIS OF CHIRONOMID MENTUM DEFORMITIES IN SNOW CREEK, CALHOUN COUNTY, ALABAMA. Kirby Swenson and Frank A. Romano, Jacksonville State University, Jacksonville, Al 36265.

Chironomids are aquatic midge fly larvae. These larvae are excellent bio-assay organisms because of **their intimate relationship with sediments and algae**. These organisms usually account for a large portion of the biomass and are preyed upon by many organisms. Thus chironomids are important to the food web of fresh water streams. Dickman, et. al. (1992) studied chironomids from clean and polluted waters and found that teratogenic chemicals cause multiple deformities of the mentum of the animal. Snow creek is a small urban tributary of Chocolocco creek and drains many industrial areas along its banks. Recently, polychlorinated biphenyls were found in the creek. Two sites were chosen, one in the heart of the industry, and one several miles downstream. The animals were collected and preserved in alcohol. The soft tissue was dissolved using KOH for easier observation. The heads were removed and the menta were examined. The site downstream was found to have a 6.5% deformation rate, and the upstream site closer to a major industrial park, showed a 20.8% deformation rate. Similar unpolluted streams in North America were found to have a 2-3% deformation rate.

BACTERIA OF THE GUT OF MELNESIUM TARDIGRADES. *Michael Marvinny*, F. A. Romano, and D. McGarey, Jacksonville State University. Jacksonville, Alabama 36265.

Bacteria are found in nearly every niche of every corner of the Earth, from thermal vents meters below the surface of the ocean to the frozen Antarctic. Virtually nothing is known about the internal niches of bacteria living in one of the least studied groups of animals, the tardigrades. In this preliminary research, methods for the study of these internal bacteria were developed. Since little is known of the life cycle of these bacteria, a single, abundant, species of tardigrade, *Melnesium tardigradum*, proved to be ideal for this study. These animals grow to a length of about 1mm which makes them easy to manipulate. Tardigrades are cryptobiotic and are able to withstand extreme conditions while in this state. In this "tun", or cryptobiotic state, they can be manipulated and tested without harming the animal or the internal bacteria, thus providing the basis for this study. Bacteria in tardigrades have been detected in TEM pictures, in studies of tardigrade internal structure, and in live experiments and observations. A comprehensive study of these internal bacteria has never been accomplished. Therefore, research on the bacteria may lead to answers to very important symbiotic questions.

Abstracts

WHICH DIMENSION DOES THE CELL DIVIDE EVENLY DURING CYTOKINESIS?

Drew M. Love, Eddie G. Moore, Dept. of Biology, Alabama State Univ. Montgomery, AL 36101 and Joel A. Swanson, Dept. of Anatomy and Cellular Biology, Harvard Medical School, Boston, MA 02115.

In an attempt to better understand the nature of cytokinesis, we developed a method to determine whether somatic cell division apportions the cell membrane or cytoplasm equally. We asked how the presence of a large intracellular inclusion, a phagocytosed latex bead, would affect this apportionment. Actively growing J774 cells, a murine macrophage-like cell line, were chosen for this study because of their phagocytic and proliferative properties. Fluorescent probes Texas Red Dextran (TRDx) and FITC-Streptavidin (SAV) were used to label the cytoplasm and the cell membrane, respectively. Adherent cells were scrape-loaded in the presence of TRDx, rinsed and resuspended in N-Hydroxysuccinimidobiotin (NHS-X-Biotin), a 244 Dalton vitamin with high affinity for avidin. These labeled cells were allowed to divide then fixed and labeled with SAV, rendering the NHS-X-biotin fluorescent. The cells were mounted in p-phenylenediamine in glycerol and observed at 40X magnification on a Zeiss fluorescence microscope. The TRDx fluorescence (cytoplasm) and FITC-Streptavidin fluorescence (cell membrane) were visualized in each of the daughter cells with a low-light TV camera. Cells without a bead divided the fluorophores equally. However, divisions in which one daughter cell received a bead and the other did not suggested the cytoplasmic volume was divided equally. Quantification by photomultiplier analysis of the SAV and TRDx fluoroscein of the cell pair vs. background fluorescence remains to be determined.

FEATURES ASSOCIATED WITH POD ABORTION IN SOYBEAN. Roland R. Dute and Curt M. Peterson, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849.

As part of a continuing study on pod abscission, an experiment was done using paired soybean racemes. One member of each pair was left untreated (control); the other (experimental) had the basal pods removed, which induced the remaining pods to continue growth. After three days the distal pods showing arrested growth in the control and continued growth in the experimental plants were removed along with their pedicels and processed for light microscopy. Starch grains were frequent in parenchyma cells of the growing sample. Amyloplasts containing clusters of large grains were located in the starch sheath of the pedicel and in a layer of parenchyma cells just distal to the vascular bundles of the ovary wall. In contrast, in arrested pods the starch grains had disappeared everywhere except from the starch sheath and parenchyma layer. Even the number of starch sheath amyloplasts in the pedicel of arrested pods was reduced significantly. Growing specimens also had a significantly greater cross-sectional area of vascular tissue in their pedicels. The arrested specimens had, as yet, no abscission zone at the base of the pedicel. Thus, metabolic processes causing arrest of pod growth were initiated before abscission zone formation.

Abstracts

mviA⁺ regulated protein A (MrpA) is associated with virulence in *Salmonella typhimurium*. W. Edward Swords and William H. Benjamin, Jr. UAB Dept. of Microbiology. Birmingham, AL 35294-0007.

Salmonella typhimurium causes a systemic disease in mice which is useful as a laboratory model for the study of the human disease typhoid fever, which is caused by the related species *Salmonella typhi*. This model is particularly relevant, as considerable data have been accumulated concerning mouse and bacterial genotypes which determine the outcome of infection. The mouse virulence gene A (*mviA*⁺) is a member of the response regulator family which is essential to the virulence of most strains of *S. typhimurium*. We have previously demonstrated that *mviA*⁺ determines virulence only in susceptible mouse genotypes. Therefore, the characterization of virulence-related genes which *mviA*⁺ regulates offers considerable insight not only into bacterial virulence mechanisms but also into the mechanisms of host resistance. We have found that strains which require *mviA*⁺ for virulence also require *mviA*⁺ for the expression of a 55 kD periplasmic protein which we have designated *mviA*⁺ regulated protein A (MrpA). MrpA was initially characterized by comparison of immunoblots of whole-cell extracts of *mviA*⁺ and *mviA::km* avirulent knockout mutants of virulent *S. typhimurium* strains. We have shown that MrpA is expressed by all virulent *S. typhimurium* strains, including those *mviA::km* mutants which remain virulent. Avirulent laboratory strains of *S. typhimurium* were shown to produce a 60 kD protein which is immunologically cross-reactive with MrpA. We have used transposon mutagenesis to isolate mutants with altered MrpA expression, and have characterized one mutant which increases MrpA expression and mouse virulence. This mutation can restore virulence to avirulent LT2 strains which previously expressed only the 60 kD MrpA cross-reactive protein. Therefore, the present data strongly indicate that MrpA is associated with the virulence of *S. typhimurium*. We are presently addressing the question of whether MrpA is a virulence factor or merely a marker of virulence.

PIT MEMBRANE STRUCTURE IN WOOD OF *DAPHNE* AND *WIKSTROEMIA*. Roland R. Dute and John D. Freeman, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849.

Pit membranes are low-resistance pathways for water movement between tracheary elements. The torus is an impermeable thickening in the center of the pit membrane and functions to strengthen the pit membrane during damage to the water-conducting system. Torus-bearing pit membranes in dicotyledonous woods occur in only a few genera. One such genus is *Daphne* in the Thymelaeaceae. All sections within the genus except for *Mezereum* have torus-bearing species. The taxonomically isolated species *D. aurantiaca* and *D. genkwa* are included among the torus-bearing species although the torus thickenings in these instances lack a G-layer. Since these two species have been placed by some investigators within the genus *Wikstroemia*, a sampling was made of species from this genus. Tori of similar structure to those of *D. aurantiaca* and *D. genkwa* were observed in three species from the subgenus *Diplomorpha*. Tori of a different morphology exist in a species that was investigated in the subgenus *Daphnimorpha*. In contrast, tori seem to be absent from two species studied in the subgenus *Euwikstroemia*. These results provide additional evidence for the close relationship between *Daphne* and *Wikstroemia*.

Abstracts

USE OF A CONDITIONAL DUAL LETHAL SYSTEM FOR THE CONTAINMENT OF GENETICALLY ENGINEERED MICROORGANISMS (GEMS). Jon Southworth, S. Molin, and Asim K. Bej, Dept. Of Biology, University of Alabama at Birmingham, UAB Station, AL 35294-1170. Dept. of Microbiology, The Technical University of Denmark, DK-2800, Lyngby, Denmark.

The deliberate or accidental release of genetically engineered microorganisms (GEMS) leading to possible unforeseen harmful effects to the environment and to human health has been the concern of public and governmental agencies since their invention. Lack of information on the growth, survival, and persistence of the GEMs, and their interaction with indigenous microorganisms in various environmental conditions has lead to the use of built-in self-destruct mechanisms for containing spread of GEMs. Several suicide systems utilizing genes of the *hok/gef* family have been reported to be useful for containment of GEMs through a lethal effect caused by lysis of host cells. However, this system allows for release of the recombinant DNAs into the environment where they may be taken up by indigenous microorganisms by natural transformation. The purpose of the current study is to incorporate the use of a nuclease gene (*snuc*) from *Staphylococcus aureus* in association with *hok* for degradation of nucleic acids as well as increased killing function utilizing two suicide targets. *S. aureus* nuclease gene was PCR amplified and cloned into pSE420 vector under *P_{trc}* promoter and *lac I_q* gene regulation. Subsequent testing of *snuc* function by viable plate count showed a decrease in cell numbers following IPTG induction, and staining of induced cells with 4',6-diamidino-2-phenylindole (DAPI) solution showed degradation of nucleic acids upon induction of nuclease. *Snuc* and *P_{trc}* promoter were then cloned into pET24 vector in association with *hok* under *lacI* control for testing of increased killing efficiency. Following induction with IPTG, viable plate counts showed a 4-fold decrease in cell numbers. Currently this system is being tested with xenobiotic degrading gene control in soil microcosms.

POLYMER EXPRESSION USING AUTONOMOUSLY REPLICATING CHLOROPLAST VECTORS. Sheila Lawrence, Chittibabu Guda, and Henry Daniell. Dept. of Botany and Microbiology, Molecular Genetics Program, Auburn University, Auburn, AL 36849-5407.

The protein based polymer gene (GVGVP)₁₂₁, which produces a biodegradable protein constituted of the repeating amino acid sequences of Glycine, Valine, and Proline, is currently being inserted within chloroplast expression vectors. Origin of replication sequences from tobacco chloroplast genomes preceding inserted genes have shown to increase the copy number of introduced plasmids in earlier studies, and will be included in the final vector sequences. The *nptII* gene, driven by the *psbA* promoter is also included, which confers kanamycin resistance and serves as a selectable marker. When all constructs are completed plasmids will be transformed into mature cultured tobacco cells using the Gene Gun, which bombards cells with tungsten particles coated with foreign DNA at high velocities. After selection, transformed cells showing expression of the introduced genes will be regenerated into mature plants.

Abstracts

Oxygen consumption of *Neritina usnea* (Röding) and the effects of salinity and temperature. G. Walter Ingram and Frank A. Romano, Jacksonville State University, Jacksonville AL 36265.

The olive nerite (*Neritina usnea*), a common gastropod, is ubiquitous to estuarine environments and located from the Carolinas through Central America. Also, it has been reported that the olive nerite can be found in a salinity range from 0 ‰ to 40 ‰. The literature on this animal, until recently, is depauperate. This project will provide information on some basic aspects of the animal's physiological ecology. Initial experiments included collecting *N. usnea* from Meaher State Park, Alabama and acclimating them in the laboratory, to different salinities (0 ‰ through 39.6 ‰) in sea water that was made using spring water and instant ocean. While at a constant temperature (20°C), osmotic stress was estimated by measuring oxygen consumption using a Clark type polarographic oxygen probe and a YSI biological oxygen monitor. All tests had several replicates and mean oxygen consumption was calculated. Initial results suggests that, while at 20°C, *N. usnea* is least osmotically stressed at 26.4 ‰, i.e., the mean oxygen consumption was lowest at that salinity. This salinity (26.4 ‰) was then held constant while the temperature was altered (10°, 20° and 30°C) and oxygen consumption was measured. Initial results showed that the mean oxygen consumption of *N. usnea* at 10°C was much lower than at 30°C, which was to be expected. Finally, both temperature and salinity were manipulated and oxygen consumption was again measured in each of these regimes to find the effects of both temperature and salinity on the oxygen consumption of *N. usnea*.

Detection of *Salmonellna* and *Vibrio* spp. in artificially contaminated shellfish using polymerase chain reaction. Chi-Ying Lee, Daniel D. Jones, and Asim K. Bej. Department of Biology, University of Alabama at Birmingham, 35294-1170.

A multiplex polymerase chain reaction (PCR) method was developed for simultaneous detection of *Salmonella typhimurium*, *Vibrio cholerae*, *V. parahemolyticus*, and *V. vulnificus* in artificially contaminated shellfish. Five sets of oligonucleotide primers were used for the amplification of the following target genes with the amplicon sizes of 152 bp *hns* (total *Salmonella*), 567 bp *spvB* (pathogenic *Salmonella*), 302 bp *ctx* (*V. cholerae*), 450 bp *tl* (*V. parahemolyticus*), and 205 bp *cth* (*V. vulnificus*). PCR amplification of DNAs extracted from the microbial pathogens followed by agarose gel electrophoresis, showed positive amplification of each of the target genes. Optimalization of PCR amplification by varying concentration of MgCl₂ (2.5 mM, 4 mM, 6 mM, and 8 mM) showed optimal condition for simultaneous amplification of all five target genes with 2.5 mM MgCl₂. To explore the feasibility of using the multiplex PCR to detect all 5 target genes in contaminated shellfish, the oyster meat homogenates were seeded with the pathogenic microbes, processed for DNA extraction, and subjected to the multiplex PCR amplification. Positive amplification of all the target genes was detected in an agarose gel, suggesting that the multiplex PCR amplification can be useful for monitoring multiple shellfishborne microbial pathogens in a single PCR reaction. Ongoing experiments are designed to evaluate the sensitivity of the multiplex PCR method in detecting each of the pathogens in artificially contaminated oyster.

Abstracts

THE FUNCTION OF PROTEINASE INHIBITORS ON HUMAN SPERM. Kimberly C. Merriwether, David J. Aarons, Gary R. Poirier, Dept. of Biology, UAB, Birmingham, AL 35209.

Proteinase inhibitors are a common component of the semen of male mammals. They may function to protect the epithelium of the male and female reproductive tracts from enzymes released from the acrosomes of dead or dying sperm. In recent years, evidence has accumulated from studies with mice that a proteinase inhibitor or its binding site on the acrosomal cap region of the sperm head participates in capacitation, zona binding, and the acrosome reaction. This presentation seeks to determine if HUSI-I, one of the two major proteinase inhibitors in human semen, may also function in important prefusion events of fertilization. HUSI-I was purified by ion exchange, affinity, and molecular sieving chromatography. The purified protein was used to raise a monospecific polyclonal antibody in rabbits. The inhibitor was localized by indirect immunofluorescence on the acrosomal cap region of freshly ejaculated sperm. When incubated for six hours under capacitating conditions, the percentage of sperm showing positive fluorescence is significantly reduced. The inhibitor does not come off of sperm incubated in a non-capacitating medium. Adding seminal plasma to capacitated cells results in sperm rebinding the inhibitor in the acrosomal cap region. Attempts to induce the acrosome reaction by immunoaggregation of HUSI-I bound to capacitated cells failed. The data suggest that HUSI-I may function as a decapacitation factor but may not be involved in zona pellucida binding or the acrosome reaction.

GEOGRAPHIC DISTRIBUTION OF THE ALABAMA REDBELLY TURTLE (PSEUDEMYX ALABAMENSIS) IN THE MOBILE DELTA. David H. Nelson and Jarrod H. Fogarty, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688.

The Alabama Redbelly turtle (Pseudemys alabamensis) is an endangered species endemic to freshwater habitats within the Mobile Bay. In order to determine specific locations where the turtles occur, hoop traps with lead nets were placed systematically in a number of sites within the lower delta of Mobile Bay from June to October, 1994. Specimens were identified, sexed, aged, weighed, measured, marked, and photographed. During the 4-month study, a total of 52 turtles were captured (including 23 Alabama Redbelly turtles). Alabama Redbelly turtles were encountered in 9 areas (Chacaloochee Bay, Grand Bay, Raft River, Big Bay John, Chuckfee Bay, Jim's Creek, Oak Bayou, Crab Creek and the Tensaw River). None were trapped in 4 other locations (Spanish River, Little Bay John, Little Bateau Bay and Big Bateau Bay). The Alabama Redbelly turtle did not appear to be extremely abundant in any of the areas studied. Other turtles encountered included Graptemys nigrinoda (n=18), Pseudemys concinna (n=5), Apalone spinifera (n=5) and Macroclmys temminckii (n=1). Eleven American Alligators and 13 species of fishes were also trapped. The study documents the presence of the Alabama Redbelly turtle in 7 locations previously unreported.

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APOSTOME CILIATES FROM THE FRESHWATER SHRIMP PALAEEMONETES KADIAKENSIS. Stephen C. Landers, Anthony Confusione, and Dewayne Defee, Department of Biology, Troy State University, Troy, AL 36082.

Ciliated protozoa from the Order Apostomatida are common symbionts of crustacea found throughout the world. Although the majority of the identified species are marine, a freshwater apostome (Hyalophysa lwoffii) is known from crayfish and shrimp in North America. This species lives encysted upon its host awaiting ecdysis. After the host molts, the ciliates then excyst and feed upon the nutrient-rich exuvial fluid found within the exoskeleton. After feeding, the cells settle on a substrate and produce daughter cells that reinfest a shrimp. Using silver impregnation, we have studied a species of Hyalophysa from Palaemonetes kadiakensis. The presence of apostomes on this shrimp is a new record for the Order Apostomatida. Additionally, the unique ciliary pattern of this species distinguishes it from the other three species within the genus. The pattern of the infraciliature is distinct with regard to ciliary rows (kineties) 1, 4, and 5, as well as with the pattern of the anterior field of kinetosomes. The uniqueness of the infraciliature rests with the appearance of a kinety 1a, a kinety formed by a splitting of kinety 1. A similar splitting occurs in kinety 5. These characteristics, combined with a distinct crook in the anterior end of kinety 4, separates the apostome found on P. kadiakensis from the other known species of Hyalophysa. The appearance of this morphological type is of interest because it possesses characteristics from both marine and freshwater species. Possibly, as more is known about the distribution of the genus, we will be able to better understand the phylogeny of the group and its appearance in distinct habitats.

EFFECT OF AMPLICON SIZE ON THE PCR-BASED DETECTION OF BIOCIDES-TREATED *Salmonella* spp. Wendy Gwin and Asim K. Bej, Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

The Polymerase Chain Reaction (PCR) method amplifies the genetic material of a target microorganism using oligonucleotide primers corresponding to a specific gene or DNA segment. The PCR has been used in detecting various microbial pathogens in clinical, environmental and food samples with high specificity and sensitivity. Since non-viable microorganisms may have intact genetic material, it is possible that PCR can amplify target DNA; providing false-positive results. In order to determine the ability of PCR to distinguish viable from non-viable microorganisms, aliquots of exponentially grown culture of *Salmonella typhimurium* 29629 were treated with 1% (v/v) sodium hypochlorite. The hypochlorite was then inactivated by the addition of 1% (w/v) sodium thiosulfate at various time intervals of 1, 5, 10, 20, 40 and 80 minutes. An aliquot of the treated samples was then plated onto agar media for total viable counts. No viable cell was detected after 20 minutes exposure to hypochlorite. Also, an aliquot (3 μ l) of the each of the hypochlorite-treated sample was subjected to PCR amplification using oligonucleotide primers that are specific for virulent genes located on the plasmid (*spv*) and on the chromosome (*inv*). PCR amplification of the *spv* gene showed amplified DNAs of 247 bp and 561 bp in samples from each time interval (1-80 min.). Also, PCR amplification of the *inv* gene showed amplified DNAs of 273 bp, 570 bp, 1230 bp, and 2031 bp in these same samples. These results suggest that the PCR method can detect both viable and non-viable *S. typhimurium* cells previously treated with sodium hypochlorite.

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DETECTION OF VIABLE BUT NON-CULTURABLE *Salmonella typhimurium* IN SHELLFISH USING POLYMERASE CHAIN REACTION (PCR). Wee-Yao Ng, Wendy Gwin, Chi-Ying Lee and Asim K. Bej, Dept. Of Biology, University of Alabama at Birmingham, UAB Station, AL 35294-1170.

Salmonella typhimurium is the causative agent of gastroenteritis in humans. *S. typhimurium* is found to be present in shellfish. Conventional methods of detection are based on the routine culturing for the presence of *S. typhimurium*. However, detection methods based on culturing has one major disadvantage in that *S. typhimurium* present in a viable but non-culturable (VBNC) state are not detectable using these methods. The purpose of this study is to determine if VBNC *S. typhimurium* in shellfish can be detected using PCR. Different amounts of VBNC *S. typhimurium* ATCC 13311 as determined by the Kogure Direct Viable Count (DVC) method and the LIVE/DEAD BacLight Viability Kit were added to 1 ml of homogenized oyster meat samples. As control, samples of homogenized oyster meat were also seeded with various amounts of live and dead cells numerated by the abovementioned techniques. DNA was extracted from the various homogenized oyster meat samples by the addition of Chelex® 100 (BioRad) resin followed by extraction with ammonium acetate and 24:1 chloroform:isoamyl alcohol. After extraction, the DNA samples were subjected to PCR amplification using oligonucleotide primers targeting the invasin (*inv*) gene resulting in an amplicon size of 570 bp. The amplified DNAs were visualized by agarose gel electrophoresis. The results indicated that VBNC *S. typhimurium* in oyster can be detected using PCR. Thus, the PCR method has an advantage over the conventional microbiological culturing method in that it is capable of detecting both viable and VBNC *S. typhimurium* in shellfish.

DIFFERENTIATION BETWEEN PATHOGENIC AND NON-PATHOGENIC SALMONELLAE BY USING POLYMERASE CHAIN REACTION. Michael G. Likos and Asim K. Bej, Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

The Polymerase Chain Reaction (PCR) is used in a variety of capacities. PCR is used to detect different microorganisms and also to differentiate different species of microorganisms. *Salmonella* spp. can cause gastroenteritis to humans through drinking water or food. Various strains of *Salmonella* could be virulent or avirulent. In order to differentiate the virulent and avirulent forms of Salmonellae, PCR is used for the amplification of a 0.570 kbp segment of the *Salmonella* Plasmid Virulence (*spv*) gene. Also, a 0.154 kbp of the *hns* gene that codes for a DNA-binding protein was co-amplified to detect all strains of *Salmonella*. A total of forty-three strains of Salmonellae were tested for simultaneous amplification of the *hns* and the *spvB* genes by multiplex PCR approach. The amplified DNA(s) from each strain was separated in an agarose gel. All 43 strains showed amplification of the *hns* gene segment. However, a number of strains showed no amplification of the *spvB* gene suggesting that not all strains are virulent. These results suggest that the multiplex PCR amplification can be useful in detecting and differentiating virulent and avirulent strains of *Salmonella* spp.

Abstracts

Growth of prothoracic glands during the last larval stadium of Manduca sexta: relation to ecdysteroidogenesis. C.-Y. Lee, K. Lee and R.D. Watson. University of Alabama at Birmingham.

The capacity of prothoracic glands to secrete ecdysteroids changes during the last larval stadium of the tobacco hornworm, Manduca sexta. The protein content of prothoracic glands was observed to change significantly during this time period. Peaks in gland protein content occurred on Day 4 (15.4 $\mu\text{g/gland}$) and Day 7 (14.6 $\mu\text{g/gland}$). These correspond to times of maximal ecdysteroid secretion in vitro. Ecdysteroid secretion in vitro was determined as a function of gland protein content for Day 1, 3, and 7 glands. For unstimulated glands, secretion increased from 0.05 ng/ μg on Day 1, to 0.54 ng/ μg on Day 3, to 1.37 ng/ μg on Day 7. For glands incubated with big PTTH, secretion increased from 0.27 ng/ μg on Day 1, to 2.05 ng/ μg on Day 3, to 2.60 ng/ μg on Day 7. The results suggested that developmental changes in secretory capacity are influenced by both the amount and type of gland proteins. Prothoracic gland protein metabolism was assessed by monitoring the incorporation of [^{35}S]methionine. A time course study revealed the rate of incorporation for Day 3 and Day 5 glands was significantly greater than the rate for Day 1 and 7 glands. Electrophoretic separation of radiolabeled gland homogenates revealed developmental changes in the pattern of protein synthesis. However, a band whose intensity changed in parallel with developmental changes in secretory capacity was not detected. Finally, BrdU immunohistochemistry demonstrated cell proliferation in Day 3-4 glands. The combined results are consistent with the hypothesis that developmental changes in ecdysteroidogenic capacity are dependent on both the amount and type of gland proteins, and on the number of prothoracic gland cells.

A PRELIMINARY BIOTIC SURVEY AND WATER QUALITY ANALYSIS OF SHOAL CREEK, CHEROKEE AND CALHOUN COUNTIES, ALABAMA. Joseph S. Covert, L. Hodge, M. Gaugler, P. Rogers, F.A. Romano, and R.D. Whetstone. Department of Biology, Jacksonville State University.

As questions of biodiversity and environmental health continue to be asked, it will become increasingly important to develop assays to determine the structure and quality of all ecosystems. Shoal Creek is a multiple impoundment creek in northeast Alabama, and is a tributary to Choccolocco Creek watershed. This creek exhibits little human influence at the headwaters with moderate to heavy human impact at the mouth. Sampling was done at five sites along Shoal Creek in the Fall 1994 and Winter of 1995. Sampling parameters included a survey of riparian vegetation and classification with regard to wetland status, concentration of various chemicals (ammonia, chloride, dissolved oxygen, carbon dioxide, and total nitrogen), physical factors (pH, temperature, cross-sectional area, and stream flow), and a survey of the benthic invertebrate communities at each site with calculation of the Family-level Biotic Index (FBI). Total bacterial and coliform counts were taken at each site as an additional parameter in the Winter sampling. Results will be discussed with regard to comparisons among sites and as to the efficiency of this testing regime in determining stream health.

Abstracts

ABERRANT CLONES OF *ACHNANTHES BREVIPES*: ONTOGENY, REPRODUCTION, AND POSSIBLE INDUCTION. Roland R. Dute, Dept. of Botany and Microbiology. Anne Estes, Dept. of Zoology and Wildlife. Kelly Griffith, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849.

In a previous study, cultured diatoms of *Achnanthes brevipes* (obtained from a biological supply company) possessed valve abnormalities associated with reduced cell length. In the present study, specimens from a second supply house as well as from the Texas Culture Collection were investigated for abnormalities and for possible reproductive stages. Diatoms from both collections frequently had abnormalities such as: branched, fragmented, or bent raphes, displaced central nodules, misshapen and displaced areolae, and incomplete silica deposition. The cells from these collections had a significantly shorter valve length than cells from a wild population collected by the Natural History Museum (London). Investigation of ontogenetic stages showed that abnormal valves were created by modifications of the normal developmental pattern. Large composite structures were present in the culture collections and might represent reproductive structures such as auxospores. Transmission electron microscopy of cultured cells showed the presence of internal valves, an indicator of osmotic stress. Since all of the cultures were grown on agar slants, it is possible that drying might be the causative factor leading to small cell size and valve abnormalities possibly through disruption of the cytoskeleton.

CHROMOSOME 6 AND NARCOLEPSY: POPULATION AND FAMILY STUDIES. Charles A. Rivers, Ken Cross, Ronald T. Acton, and Rodney Go. Department of Microbiology, University of Alabama at Birmingham, Birmingham, AL 35293-0012.

Narcolepsy (Nar) is a sleep disorder characterized by chronic sleepiness, irresistible sleep attacks, and one or more of the following: cataplexy, sleep paralysis, hypnagogic hallucinations, and disturbed nocturnal sleep. Nar has been reported to be associated at near 100% with the alleles HLA-DRB2 and DQBw1. We compared the frequency of several very polymorphic loci on human chromosome 6p (C6p) in Nar with race, age, sex, and demographic region matched controls and within families.

DRB2 and DQBw1 were found to be at significantly higher frequencies than in the control populations ($p=0.001$ and $p<0.02$, respectively); however, there was not a near 100% association observed (60% DRB2 and 60% DQBw1). Other loci, spanning 20.8Mb of C6p, were found to segregate with different aspects of the disease state, like cataplexy, in different racial groups; this suggests narcolepsy may be multifactorial.

When typing families for defining haplotypes on C6p, a total of 20 recombination events were detected. Thirty percent of the crossovers occurred between DQB and DRB, a region traditionally in linkage disequilibrium with $<0.2\%$ expected rate of recombination. The data suggests this site is a position for the disease locus.

Abstracts

TEMPORAL AND SPATIAL PATTERNS OF DIETARY RESOURCE UTILIZATION IN THE ECHINOID *LYTECHINUS VARIEGATUS*.

Steven D. Beddingfield and James B. McClintock. Department of Biology, University of Alabama at Birmingham.

Lytechinus variegatus is a widely distributed regular echinoid found in abundance in St. Joseph's Bay, Florida. Field investigations indicate this echinoid inhabits *Thalassia*, *Syringodium* and sand/*Enteromorpha* dominated microhabitats within the Bay. Differences occur in growth, reproductive output and recruitment rates of individuals inhabiting these different microhabitats. These factors may be related to differences we have documented in microhabitat-specific temporal and spatial patterns of food availability. In addition, laboratory studies indicate differential growth and nutrient allocation in *L. variegatus* occurs in response to qualitative characteristics of their natural diets. This work is supported by NSF EPSCoR grant #635802 and the UAB Department of Biology.

SPORANGIAL DISCHARGE OF *PILOBOLUS* (ZYGOMYCETES). Banyon A. Allison, Jeffrey L. Brewster, William R. Bowen and Noriyoshi Terashima. Dept. of Biology, Jacksonville State Univ., Jacksonville, AL 36265.

Asexual reproduction in the zygomycetan fungus, *Pilobolus*, involves the explosive discharge of intact black sporangia from erect sporangiophores that chaaracteristically develop on the dung of such ruminants as the horse. Previous studies (Buller, 1958; Page, 1964; and others) clearly demonstrated that, as the sporangiophore reorients towards the morning sun, the bulbous subsporangial region swells until the terminal sporangium literally and audibly is discharged, i.e., "blown off." The ensuing explosion shoots the sporangium through the atmosphere several feet until it interacts with a blade of grass in such a way as to become cemented to that substrate. In this paper, we report on two preliminary studies of this unique and natural fungal "shotgun." In the first study, the orientation of sporangiophores towards a light source influenced the distribution of discharged sporangia, i.e., the accuracy of the "shotgun." In the second, the adherence of sporangia to a substrate after drying was found to be exceedingly tenacious.

Abstracts

NEOTROPICAL MIGRATORY BIRD SURVEY AT FORT MCCLELLAN, AL.

Eric C. Soehren and George R. Cline, Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

Bird censuses over the last few decades have revealed declines in neotropical songbirds that breed in North America. These declines have been attributed to factors such as deforestation on their wintering grounds and forest fragmentation on their breeding grounds. An investigation was conducted at Fort McClellan, Alabama to determine neotropical species richness in different sized forest fragments. These fragments ranged from as large as 586.2 ha. to as small as 4 ha. Regression analysis of data for fragments up to 90 ha. shows that there is a significant relationship between fragment sizes and species richness of neotropical species ($p < 0.05$, $r^2 = 0.573$). Species that require large fragments were discovered in smaller forest fragments. Results of my surveys are compared with results from Maryland (Robbins, C. S. et al., 1989. Wildl. Monogr. 103:1-34).

CHEMISTRY

MONITORING THE KRAFT PULPING PROCESS IN REAL TIME BY CAP - ILLARY ZONE ELECTROPHORESIS. Moore U. Asouzu, Shawn Anderson, Christine Jernigan, Stacy Hunt-DuVall, Department of Physical Science and Chemistry, Troy State University, Troy, AL 36082.

Real-time monitoring of the hydroxide, carbonate, sulfate, chloride, thiosulfate, and sulfite ion concentration in liquors (white, black, and green) is crucial to the efficiency of the kraft pulping process. Significant portion of mill time is dedicated to the monitoring of these anions in the liquors. The composition of the liquors obtained from the combustion of the black liquor and regeneration of the white liquor is indicative of the efficiency of this operation. Additionally, these liquor profiles can be used along with other parameters to project the probable quality of the final product. Several off-line volumetric and gravimetric methods are currently used to analyze liquors for these anions. The usefulness of these wet-chemical methods is limited by the complex nature of the liquors. Often, elaborate sample pre-treatments are required to obtain liquor samples that are suitable for analysis by these methods. Furthermore, these time-consuming methods are not conducive to real time operations where the status of the present determines future decisions about a process. This paper will present a possible alternative to these wet-chemical methods based on the established indirect CZE technique. Labview is used to automate this system from data acquisition to analysis.

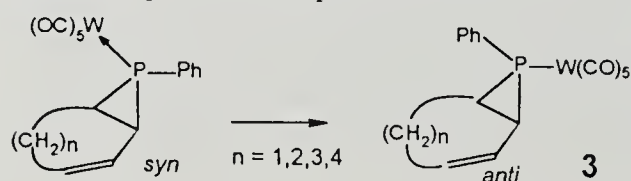
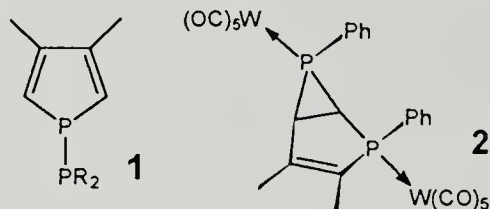
Abstracts

TRIMETHYLENE SULFIDE DIMER RADICAL CATION REACTIONS AND REARRANGEMENTS. Michael Peschke, Michael L. McKee and Andreas J. Illies, Department of Chemistry, Auburn University, AL 36849-5312

An experimental and computational study of the ion-molecule reactions of the TMS dimer radical cation formed from the monomer and its monomer cation, have been carried out. The experiments were done mainly in a hybrid drift tube/ion source under chemical ionization conditions. The standard level for our computations was PMP2/6-31G(d)//HF/6-31G(d). Experimentally, the most abundant species under essentially all conditions is m/z 106 $S_2C_3H_6^+$. Computations suggest a cyclic structure with the sulfur inserted into the ring rather than an exocyclic sulfur attached to the TMS ring. This is analogous to an earlier published study of thiirane in which m/z 92 $S_2C_2H_4^+$, m/z 124 $S_3C_2H_4^+$ and m/z 156 $S_4C_2H_4^+$ were observed in the mass spectra. Those rings were attributed to sulfur insertion into the ring of one of the parent clusters and ejection of ethylene. In the present case, computations indicate a mechanism in which the TMS dimer cation undergoes several bonding rearrangements resulting in sulfur insertion into the TMS ring and after a few more steps including two hydrogen transfers propylene is ejected. All of the intermediates and transition states are exothermic with respect to the monomer plus monomer cation. In addition, computations indicate a very stable eight membered ring, 1,5-dithiacyclooctene radical cation, as an intermediate which has the same mass as the dimer, m/z 148. 1,5-dithiacyclooctane is known to dissociate into m/z 106 and C_3H_6 in the mass spectrometer. Further ring expansion is not observed. Computationally, it is found that the ring $S_3C_3H_6^+$ plus propylene is endothermic with respect to the monomers, explaining the end of the ring expansion.

PHOSPHINIDENES – NEW DIRECTIONS. Bing Wang and Koop Lammertsma, Dept. of Chemistry, University of Alabama at Birmingham, UAB Station, Birmingham 35294.

In our studies to expand scope in which the carbene-like chemistry of phosphinidenes can play an important role we recently had a need to explore the properties of starting materials and products. We wanted to determine in more detail the reactivities of the 5-membered phosphole and 3-membered phosphirane systems. Particularly, challenging are the P-substituted phospholes as the N-, Si-, and Sn-derivatives attest to. We developed the syntheses to several new phosphino-derivatives **1**. To our surprise phospholes are susceptible to addition reactions as the phosphinidene addition illustrates. This uniquely strained compound has exceptional P- and W-conformations with fused 3- and 5-membered rings.



Strained structures are important and versatile synthons. The phosphiranes are no exception. We will illustrate this by its unique biradical pathway for rearrangements as shown for **3**.

Abstracts

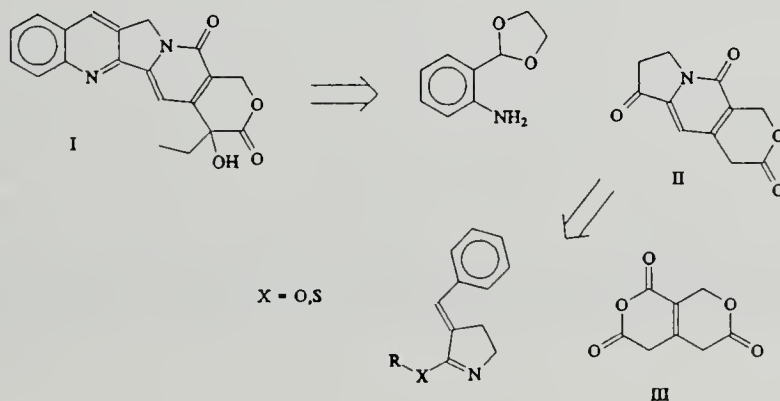
Association and Bimolecular Ion-Molecule Reactions of Small Sulfur Ring Systems

Mary A. James, Jennifer Gidden, Michael Peschke and Andreas Illies*
Department of Chemistry, Auburn University, AL 36849-5312

The association and bimolecular reactions of thiirane with trimethylene sulfide radical cation were investigated. The ion-molecule experiments were done with a highly modified DuPont mass spectrometer with a hybrid drift tube/ion source and the metastable and CID experiments were done with a ZAB-1F. We have shown that the bimolecular reactions lead to ring expansion by incorporation of Sulfur atoms into one of the rings when the cyclic ions react with the cyclic neutrals. The goals of our studies are to investigate the driving forces and mechanisms for the branching between association or bimolecular ring expansion paths. Product ions observed in the mixed system but not in the ion-molecule reactions of pure thiirane (cSC_2H_4) nor pure trimethylene sulfide (cSC_3H_6) were m/z 134, m/z 138. The fragmentation of these ions by metastable and CID MS/MS techniques are under current investigation. The m/z 134 product peak was initially thought to be the mixed cluster of thiirane and trimethylene sulfide radical cation with a 2c-3e Sulfur-Sulfur bond. Metastable studies indicate this species fragments into m/z 92 (a four membered ring with two Sulfur atoms) instead of the expected thiirane (m/z 60) or trimethylene sulfide (m/z 74) radical cation. The bimolecular product peak m/z 138 is a six membered ring which contains three Sulfur atoms. This six membered ring undergoes association reactions with thiirane and/or trimethylene sulfide to produce interesting cluster ions.

IMIDATE-ANHYDRIDE CONDENSATIONS AS A ROUTE TO CAMPTOTHECIN INTERMEDIATES. Forrest T. Smith and Tara Colley, Department of Pharmacal Sciences, School of Pharmacy, Auburn University.

Camptothecin(I) has been a popular synthetic target since its discovery in 1966, due to its activity as an anticancer agent. Although numerous total syntheses have been reported, until recently all have been lengthy and low yielding. Retrosynthetic analysis of I suggests that condensation of protected ortho-amino-benzaldehyde and II may be a successful strategy for the total synthesis of camptothecin if II could be produced in high yield. Toward this end model reactions involving the condensation of anhydrides with imidates or thioimides to give compounds such as II were studied. Results indicate that the condensation is accompanied by decarboxylation and such a strategy may be applicable to the synthesis of I.



A COMPREHENSIVE LABORATORY MANAGEMENT PROGRAM FOR ALABAMA HIGH SCHOOL CHEMISTRY TEACHERS. Larry Krannich and Lee Summerlin, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

During the past two years, we have been conducting an NSF-sponsored Laboratory Management program for experienced high school chemistry teachers. This program is based upon the premise that the laboratory is central to the teaching of chemistry and that teachers lack experience in managing the laboratory aspects of chemistry in light of rules, regulations, and fear of legal action. Our program is organized around three thrust areas: Laboratory Instruction, Laboratory Procedures, and Laboratory Management. The responsibility of the teacher in the laboratory is emphasized. Sessions are conducted with legal experts to clarify acceptable teacher practices and to present scenarios that might involve liability. We stress new approaches to laboratory instruction and focus on the lab as a setting for developing higher order thinking and manipulative skills. Specialists from industry and research organizations serve as resources to provide a thorough indoctrination into the many facets of laboratory operation. By the conclusion of the program, each teacher has received chemistry safety specialist training and has developed a customized laboratory management and safety program. The results from cognitive and attitudinal assessment instruments used in pre- and post-program settings will be discussed.

ROTATIONAL INVARIANCE IN QUANTUM CHEMICAL FORCE CALCULATIONS. Tracy P. Hamilton, Dept. of Chemistry, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

A large part of the computer time that is consumed in optimizations of molecular structures is for the evaluation of the derivatives of the two-electron integrals. Translational invariance is used to reduce the number of derivative integrals from $12N^4$ to $9N^4$, where there are N^4 integrals originally. This comes from the fact that the derivative of a four center integral gives four derivative integrals, and derivatives with respect to x,y and z are required. Translational invariance allows the derivatives with respect to the fourth center to be written as the negative of the sum of the other three. Rotational invariance can further reduce the number of derivative integrals to $6N^4$, but more logic is involved which has made it impractical to implement up to the present. By recognizing that the linear systems of equations that arise from the rotational invariance conditions can be done just once for any combination of four centers, utilization of rotational invariance is practical. The changes required in the computer algorithms will be discussed for two types of basis functions, cartesian gaussian functions and scaled Hermite gaussian functions.

USING NMR TO UNRAVEL ORGANOALANE/SILYLPHOSPHINE REACTIVITY. Steven Schauer, Charles Watkins, and Larry Krannich, Dept. of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294.

^1H , ^{13}C , and especially ^{31}P variable temperature FT-NMR has been used to probe the pathways involved in the reactions of Me_3Al and R_2AlH ($\text{R} = \text{Me}, \text{Bu}^i$) with the silylphosphines $\text{P}(\text{SiMe}_3)_3$ and $\text{HP}(\text{SiMe}_3)_2$. At room temperature, Me_3Al forms stable adducts with $\text{P}(\text{SiMe}_3)_3$ and $\text{HP}(\text{SiMe}_3)_2$. Prolonged heating of $\text{Me}_3\text{Al} \cdot \text{HP}(\text{SiMe}_3)_2$ results in $[\text{Me}_2\text{AlP}(\text{SiMe}_3)_2]_2$ formation. Me_2AlH reacts at low temperature with $\text{P}(\text{SiMe}_3)_3$ to yield $[\text{Me}_2\text{AlP}(\text{SiMe}_3)_2]_2$ and Me_3SiH . Bu^i_2AlH reacts similarly with $\text{P}(\text{SiMe}_3)_3$, but the reaction rate is much slower. The reaction of Bu^i_2AlH with $\text{HP}(\text{SiMe}_3)_2$ results primarily in the formation of $[\text{Bu}^i_2\text{AlP}(\text{SiMe}_3)_2]_2$ via H_2 elimination. On the other hand, the reaction of Me_2AlH and $\text{HP}(\text{SiMe}_3)_2$ is more complex and occurs initially with Me_3SiH elimination to give the intermediate $\text{Me}_2\text{AlP}(\text{H})\text{SiMe}_3$, which then participates in subsequent reactions. The production of H_2PSiMe_3 and PH_3 during reaction suggests that transphosphination is an important process in the formation of the observed product. We will discuss the use of coupled and decoupled ^{31}P NMR to elucidate the reaction pathway to the major product, the mixed trimeric species, $[\text{Me}_2\text{AlP}(\text{H})\text{SiMe}_3]_2 \cdot \text{Me}_2\text{AlP}(\text{SiMe}_3)_2$.

AUTOMATING WITH LABVIEW - A TIME SAVING OPTION? Shawn Anderson and Moore U. Asouzu, Department of Physical Science and Chemistry, Troy State University, Troy, AL 36082.

Automating instruments with Labview is a well established option in the engineering discipline. In order to automate with Labview, one only needs to provide a scaleable input waveform that can describe a system of interest, for example, the output signal of a gas chromatograph. In this sense, Labview is no different than all the other automating packages. But, this similarity ends here! In Labview programming, control and analysis codes are written by logically connecting (wiring) dedicated virtual instruments (Vis) based on the application sought. From our experience, wiring together VIs saved us about half the usual time required to write and debug most interfacing source codes. The Labview package comes with a substantial library of these virtual instruments. Once one learns the fundamentals of this system, it is "plug in and play." The "plug in" is the analog I/O board. We have created several general purpose VIs. In this poster presentation, we will share these VIs with everyone that this system interests.

REACTIVITY OF SILYLAMINES TOWARD Me_3M ($\text{M} = \text{Al}, \text{Ga}, \text{In}$). Eric Styron, Charles Watkins, Larry Krannich, and Steven Schauer, Department of Chemistry, University of Alabama at Birmingham, Birmingham, Alabama, 35294

^1H and ^{13}C FT-NMR was used to investigate the reactivity of the silylamines, $\text{N}(\text{SiMe}_3)_3$, $\text{MeN}(\text{SiMe}_3)_2$, $\text{Me}_2\text{NSiMe}_3$, $\text{HN}(\text{SiMe}_3)_2$, and $\text{HN}(\text{Me})\text{SiMe}_3$, toward Me_3M ($\text{M} = \text{Al}, \text{Ga}$, and In) in 1:1 reaction mixtures. Adduct formation in solution was noted by chemical shift changes for the amine or Me_3M moieties that occur upon reactant mixing. Adducts were observed for all three metal derivatives with the less sterically hindered amines $\text{HN}(\text{Me})\text{SiMe}_3$ and $\text{Me}_2\text{NSiMe}_3$, while no adduct formation was detected with the more bulky amines. 1,2-elimination was observed for the two secondary amines, $\text{HN}(\text{SiMe}_3)_2$, and $\text{HN}(\text{Me})\text{SiMe}_3$. Upon heating to 90°C , the ease of elimination with $\text{HN}(\text{Me})\text{SiMe}_3$ and Me_3M was observed to depend upon the nature of the Group 13 metal: $\text{Al} > \text{In} > \text{Ga}$. These reactions formed the dimeric species, $[\text{Me}_2\text{MN}(\text{Me})\text{SiMe}_3]_2$, which was independently synthesized and characterized. $\text{HN}(\text{SiMe}_3)_2$ displayed slow reactivity with Me_3Al even at room temperature, while Me_3Ga and Me_3In showed no reactivity upon prolonged heating at 90°C . The reactivities of these silylamines toward Me_3M will be discussed and compared with those observed for silylphosphines.

CAPILLARY ELECTROPHORETIC TECHNIQUES FOR THE MEASUREMENT OF ADENOSINE. CHAO-CHENG WANG¹, WILLIAM P. McCANN², and STEPHEN C. BEALE¹, Department of Chemistry¹ and Pharmacology², The university of Alabama at Birmingham, Birmingham, AL 35294

Reliable quantitative measurement of adenosine at nanomolar concentration levels found in plasma and urine is required to better understand the roles of adenosine in several physiological systems, such as coronary and cerebral circulations. The existing methods, such as reverse-phase HPLC, suffer from lack of sensitivity, artifact peaks, and need of rather large blood samples. Capillary electrophoretic (CE) techniques, with the advantages of minimal sample requirements, high efficiency and low mass detection limits, appear to be suitable for the analysis of plasma adenosine.

On-column transient isotachophoretic preconcentration (ITP) and laser-induced fluorescence (LIF) detection are employed to improve the concentration detection limits of CE techniques. Fluorescent 1, N^6 -etheno-derivatives of adenosine are formed by reaction of the adenine base with chloroacetaldehyde. Excitation at 325 nm (the UV line of the He-Cd laser) allows for the selective detection of etheno-adenosine in the presence of other interfering species. Boric acid buffer ($\text{pH}=10$) converts the neutral etheno-adenosine derivatives into anionic borate complexes and functions as the terminating electrolyte for the ITP preconcentration step and background electrolyte for CZE separation in a single column ITP-CZE system. Injection volumes as large as 50% of the column volume can be made without degradation of the separation efficiency, resulting in enhancements of concentration detection limits by two orders of magnitude.

Results from comparison of free-zone capillary electrophoresis and on-column ITP-CZE are presented. Quantitative measurement of adenosine at the nanomolar concentration levels expected in plasma or urine will be presented. Preliminary investigation into the simulative sampling of adenosine by microdialysis and ultrafiltration techniques will be presented.

Abstracts

GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC ANALYSIS OF ACYLATED DERIVATIVES OF METHAMPHETAMINE AND REGIOISOMERIC PHENETHYLAMINES. Jack DeRuiter, C. Randall Clark, Allen K. Valaer and F. Taylor Noggle, Department of Pharmacal Sciences, School of Pharmacy, Auburn University, Alabama and Alabama Department of Forensic Sciences, Auburn, Alabama 36830

The analytical profiles of methamphetamine and four isomeric phenethylamines (phentermine, 1-phenyl-2-butanamine, N,N-dimethylphenethylamine and N-ethylphenethylamine) are very similar making it difficult to differentiate between these compounds. All five amines have a MW = 149, contain an unsubstituted benzyl moiety, and are regioisomeric within the imine fragment each showing a base peak in the electron impact mass spectrum at m/z 58. Furthermore, these compounds show similar gas chromatographic retention properties on methylsilicone (HP-1) and phenylmethylsilicone (HP-5) stationary phases. Thus, without reference standards it is difficult to specifically differentiate methamphetamine from the other isomeric amines. The four primary and secondary amines were acylated with acetyl-, trifluoroacetyl-, pentafluoropropionyl-, heptafluorobutyryl- and 4-carbethoxyhexafluorobutyryl- groups in an effort to obtain more specific structural information from mass spectrometry and improve chromatographic resolution. The pentafluoropropionyl amide derivatives provided adequate GC resolution and mass spectra which can be used to differentiate among these regioisomeric amines. The underivatized amines showed different R-values in TLC drug screening procedures, but very similar responses to all visualization reagents. Cross-reactivity was observed in drug screening methods based upon immunoassay methods for the four primary and secondary amines.

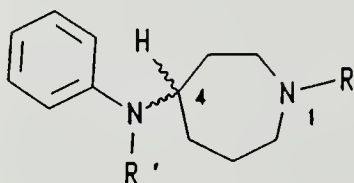
AN IN-SERVICE PROGRAM ON USING THE CHEMISTRY LABORATORY TO DEVELOP MATH SKILLS. Larry Krannich and Lee Meadows, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

We have conducted an in-service program, which was sponsored by the Dwight David Eisenhower Math and Science Program, for Alabama chemistry teachers during the summer. This program is designed to assist the teachers in their development and utilization of effective strategies to assess, address, and overcome student difficulties in integrating math skills, science content, and technology applications in chemistry. The teachers concentrate on the chemistry laboratory as a vehicle for teaching students to understand the synergy of concepts involved in a problem, recognize concept links, facilitate development of mental analogies, and develop viable problem solving techniques. After all, the chemistry laboratory is a dynamic site for integrating science, mathematics, and technology, especially when laboratory explorations involve stoichiometric applications. Herein, scientific process skills are used and technology applied in data collection and mathematical manipulation. Through the use of the graphing calculator, we reinforce their problem skills' development. The program will be discussed and the teachers' response to the workshop will be reviewed. The pre- and post- assessment instrument results will be presented.

Abstracts

SYNTHESIS AND RESOLUTION OF RACEMIC 4-(PROPANANILIDO)PERHYDRO-AZEPINE ANALGESICS. Shridhar Andurkar, Jack DeRuiter, Thomas N. Riley and C. Randall Clark, Department of Pharmacal Sciences, School of Pharmacy, Auburn University, AL 36849.

Earlier we reported the synthesis of a number of racemic 4-(propananilido)perhydroazepines (2a-f) as potential analgesic agents. Selected compounds in this series (2c and 2d) display analgesic activity equal to or greater than morphine in the mouse tail flick assay. In this study we have explored the synthesis of enantiomers of 2 to investigate the importance of stereochemistry at the 4-position on analgesic activity. Of the approaches investigated to date, resolution of diastereomeric salts of 1 by fractional recrystallization has proved most successful. The enantiomers of 1 can be synthetically elaborated to the target compounds 2 by N₁-alkylation followed by propionylation. Efforts directed toward the resolution of key intermediates and chromatographic methods developed to monitor the resolution processes will be described.



- 1 R' = R = H
- 2a R' = COEt, R = H
- 2b R' = COEt, R = CH₂C₆H₅
- 2c R' = COEt, R = CH₂CH₂C₆H₅
- 2d R' = COEt, R = CH₂CH(OH)C₆H₅
- 2e R' = COEt, R = CH(CH₃)CH₂C₆H₅
- 2f R' = COEt, R = CH(CH₃)CH(OH)C₆H₅

PAINT FILM SAPONIFICATION KINETICS MEASURED BY ELECTRICAL CONDUCTIVITY. Allison G. Dollar and Michael B. Moeller, Department of Chemistry and Industrial Hygiene, University of North Alabama, Florence, AL 35632.

An alternative technique to abrasive blasting for safely removing lead containing paint from steel structures is to use chemical paint strippers. Alkyd resin paints are subject to saponification by strongly alkaline solution and a quantitative method for measuring reaction rate would be useful in optimizing stripper formulations. Our research studied electrical conductivity as a method for measuring the rate of attack of an alkaline stripper on a paint film. Of the several features repeatedly observed in the relationship of conductivity versus reaction time, the most discernable was the time elapsed for maximum slope. Still, the variability between replicate trials was large having an estimated standard deviation of 33%. By calibrating the samples with a standard, the estimated standard deviation for a trial was reduced to 17%. This precision was adequate to show that, for aqueous hydroxide concentration between one and four molar, the order of the reaction with respect to hydroxide concentration is significantly less than one.

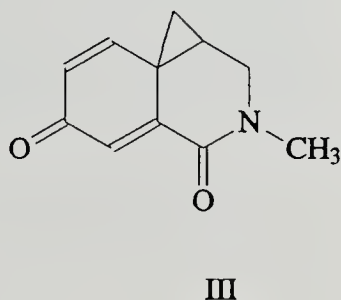
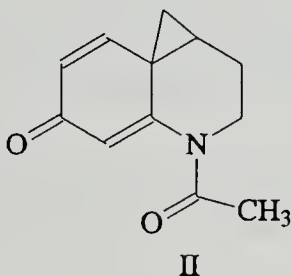
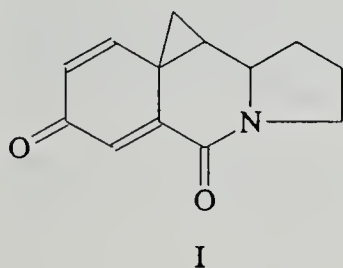
Abstracts

SIMPLEX OPTIMIZATION OF TWO CHEMICAL SYSTEMS. Moore U. Asouzu, Department of Physical Science and Chemistry, Troy State University, Troy, AL 36082.

This paper describes the optimization of the experimental conditions for the determination of L-lactate by enzyme-amplification, and for the molybdate-catalyzed iodometric determination of hydrogen peroxide in a flow injection analysis system. A computer program based on the modified-simplex algorithm was used to calculate each point in $n+1$ dimensional hyperspace that corresponds to a set of experimental conditions in the simplex. In the lactate system, the simplex search was based on S/N ratio while net absorbance (signal - background) was used for the molybdate-catalyzed system. Convergence (optimum factor levels) was established for each system when the resultant improvement in each function ceased to be significant or met a pre-specified value. The level of factors at convergence were then accepted as optimum. The value calculated for each factor at convergence was re-confirmed by starting a new simplex from a different location on the hyperspace. Finally, values obtained from univariate maximization of the same systems were compared to those from the simplex search.

SYNTHESIS AND MODELING OF CYCLOPROP[1,2-c]QUINOLINES AND RELATED COMPOUNDS. Venkatram R. Atigadda and Forrest T. Smith, Department of Pharmacal Sciences, School of Pharmacy, Auburn University, Auburn, Alabama 36849.

In an effort to synthesize sequence specific alkylating agents of DNA, I, which incorporates several key structural features of CC-1065 and Anthramycin, was identified as an initial target. A precursor to I was synthesized by condensing 7-benzyloxy-homophthalic anhydride with pyrroline followed by reduction, mesylation and debenzylation. However, formation of the cyclopropane proved to be problematic. In order to gain insight into the failure of the ring closure, the reaction was modeled using the AM1 method. These studies prompted pursuit of alternative targets such as II and III. Modeling results and synthetic efforts towards these compounds will be discussed.



FREE-RADICAL CHLORINATION OF HALOGENATED BUTANES.

James L. Lambert, SJ; Tony L. Goodman, Matthew N. Simmons;
Spring Hill College, Mobile, AL 36608-1725

Free-radical monochlorination of pentane, and of the 1- and 2-chloro-, bromo- & iodo-butan-1-ols has been studied. The chlorination was effected at 80 °C with sulfuryl chloride as the chlorine source and 2,2'-azobis-(2-methylpropionitrile) (AIBN) as the radical initiator. Analysis of the product mixtures was done by gas chromatography with a mass selective detector. The relative-reactivities for the different substitution sites were determined. Relative-reactivity is rationalized by consideration of hyperconjugative interactions of the carbon-radical with neighboring carbon-hydrogen and carbon-carbon sigma-molecular orbital electron pairs. Experimental data suggest that a neighboring carbon-chlorine sigma-molecular orbital electron pair does not interact by hyperconjugation; nor does the halogen influence the carbon-radical's stability by inductive or resonance interactions. Also, it is observed that the halogen's steric effect favors the formation of one diastereomer in the 2,3-dihalobutane products.

CHEMICAL INVESTIGATION OF PROTEIN CONTACT SITE(S). YI-HSUAN HUANG and STEPHEN C. BEALE, Department of Chemistry, The University of Alabama at Birmingham, Birmingham, AL 35294

A methodology to identify the amino acids at the active site(s) or contact site(s) of protein will be introduced in this presentation. This methodology is based on a chemical modification strategy to target amino acid residues at the active site(s) or contact site(s) of a particular enzyme. Our initial efforts have keyed on lysine residues using Ribonuclease A (RNase A) as a model protein. The lysine residues are modified by glyceraldehyde in the presence of the reducing agent. Stoichiometric control of the chemical modification reagent allows an average of one lysine residue per enzyme to be achieved. The extent of lysine residues modified will be investigated by fluorometric assay of the free primary amine content and peptide mapping by capillary electrophoresis (CE).

The fraction of RNase A with inhibited activity which results from the modification of lysine residues at the active site will be isolated based on affinity chromatography. A population of RNase A modified at a single lysine residue is obtained. After proteolytic digestion of the isolated population, the resultant peptides will be characterized by capillary electrophoresis. Subsequent sequence analysis of the peptides will reveal the position of the active site for the protein.

Results obtained by fluorometric assay of the extent of lysine residues of RNase A modified by glyceraldehyde will be presented. Results from the isolation of the binding incompetent RNase A by DNA affinity column will also be presented.

Abstracts

SYNTHESIS AND CHARACTERIZATION OF THE TRANSITION METAL COMPLEXES OF O,O'-BIPHENOL-DERIVED BIS(PHOSPHITE) LIGANDS. Maheśwaran H., Carlos Quintana and Gary M Gray, University of Alabama at Birmingham, Department of Chemistry, OB15-242.

Bis(phosphines) are widely used as ligands because the chelate complexes, which they form, are very stable and often show catalytic activity. In contrast, until recently, bis(phosphites), which also form stable complexes, were seldom used as ligands in catalysis. One interesting group to use in the synthesis of bis(phosphites) is o,o'-biphenol because this group could result in unusual conformations in the chelating ring. This work could be extended to the use of o,o'-binaphthol to generate chiral transition metal complexes, which could have applications in enantioselective catalysis. In our laboratory, we have synthesized the transition metal complexes of various o,o'-biphenol-derived bis(phosphite) ligands. The solution-state and solid-state conformations of these complexes have been studied using NMR and X-ray crystallography, and these results indicate that the complexes have very interesting properties. The synthesis and characterization of these complexes as well as their conformational characteristics will be discussed.

TEMPERATURE CONTROL OF NUCLEATION AND GROWTH OF LYSOZYME CRYSTALS. Rita J. Gray and Lawrence J. DeLucas, Center for Macromolecular Crystallography, The University of Alabama at Birmingham, 1918 University Blvd., Box 79 THT, UAB Station, Birmingham, AL 35294-0005 and W. William Wilson, Department of Chemistry, PO Drawer CH, Mississippi State University, MS 39762.

Temperature influences nucleation and growth of protein crystals by modifying the solubility and therefore the supersaturation of macromolecules. We have used temperature in conjunction with light scattering to monitor nucleation events during the initial phases of protein crystal growth. This permits the nucleation and growth phases to be separately controlled. Results of the temperature control on the extent of nucleation and growth of lysozyme crystals will be discussed. This work was supported by NASA contract No. NAS8-40190.

Abstracts

PHOSPHATE FIBERS. Edward J. Griffith, Monsanto Company, 800 North Lindbergh Blvd., St. Louis, Missouri, 63167.

Condensed phosphates may be as small as pyrophosphates in adenosine diphosphate to gigantic molecules found in Kurrol's salts and phosphate fibers containing thousands of PO_3 groups per molecule-ion. Condensed phosphates are required components of all living systems in molecules as diverse as ATP and DNA. They are excellent material for safe products where human, animal, and vegetable life is contacted.

Phosphate Fibers are prepared inorganic polymers with structures similar to natural mineral fibers based upon silicates. Condensed phosphates hydrolyze to safe nutrients when contacted by moisture. The hydrolytic degradation is known to be accelerated by enzymes of the type found in living systems.

This talk will tell of the preparation and properties of crystals of inorganic polyphosphates having structures and properties similar to serpentine minerals, but without the potential health hazards of mineral fibers.

ALKALI-PEROXYNITRITE SALTS - A CASE STUDY IN SYMMETRY BREAKING. Hui-Hsu Tsai, Tracy P. Hamilton, Jyh-Hsin Tsai, Joseph G. Harrison and Joseph S. Beckman, Depts. of Chemistry, Physics and Anesthesiology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

Peroxynitrite is an important molecule in biological chemistry formed from NO and superoxide. As part of an effort to confirm earlier assignments of Raman spectra in basic aqueous solution to the *cis* isomer, we have computed the vibrational spectra and isotopic frequency shifts of alkali peroxynitrite (MOONO , $\text{M}=\text{Li}, \text{Na}, \text{K}$) for comparison with matrix isolation infrared spectra. The unusual behavior of the predicted *ab initio* frequencies are similar to the symmetry breaking phenomena of LiO_2 and NaO_2 . We tested many different density functional methods in an effort to ascertain the best density functional for this highly correlated electronic system. Agreement between theory and experiment for the Becke3LYP density functional is by far the best. The calculations confirm that two isomers of MOONO have been detected, a *cis-cis* form and a *trans-cis* form. The only difference between the structures is whether the ONOO torsion angle is 0 or 180 degrees.

Abstracts

PROTON NMR STUDY OF THE RELATIVE STRENGTHS OF ORTHO-PARA DIRECTORS. Andy Harrell, Ben Roberts, and Dr. Clyde Stanton, Dept. of Chemistry, Birmingham-Southern College, Birmingham, AL 35254.

An important tool in the realm of undergraduate learning is access to a working NMR. This type of equipment quickly gives tangible data that can supplement the classroom experience. The major objective of this project was to examine the relative strengths of -OH, -Cl, and -CH₃ as ortho-para directors on the benzene ring. We synthesized substituted benzene ring compounds using a Friedel-Crafts reaction and then examined the compounds using the EM-360A NMR spectrometer. Based upon the NMR spectra we generated and standard NMR spectra, we conclude that the ortho-para directors we examined have the following relative strengths: -OH>Cl>CH₃. We will also discuss the results of these experiments in the context of simulated NMR spectra generated with the quantum mechanics based LAOCN3 software package.

POLY(ORGANOPHOSPHONATE)S: UNIQUE ORGANIC/INORGANIC MATERIALS. Keith E. Branham and Gary M. Gray. Department of Chemistry, 242 OB15, The University of Alabama at Birmingham, Birmingham, AL 35294. Prakash C. Bharara, Department of Chemistry, University of Montevallo, Montevallo, AL 35115.

Poly(organophosphonate)s are interesting organophosphorus polymers prepared by the stoichiometric polycondensation of dimethylphosphite with diols or by the transesterification of poly(organophosphonate) oligomers having only phosphonate end groups. Side reactions in these polymerizations limit the molecular weight (MW) of the polymers prepared unless the reaction mixture is treated with diazomethane during the early stages of the polymerization. High MW poly(organophosphonate)s prepared by these methods can be functionalized by nonoxidative chlorination and then reacted with metal complexes to prepare unique metal-containing polymers.

Instrumental Color Analysis of Pyrotechnically Generated Flames. Brian Melof, and Clyde T. Stanton, Department of Chemistry, Birmingham-Southern College, Birmingham, Alabama 35254.

The wavelength and intensity of light emitted by pyrotechnics depend on the nature and amount of fuel, oxidizer, and color agent present in the composition. Color intensity and color purity are the physical characteristics of emitted light which affect human perception of a colored flame. This study was initiated on a red pyrotechnic mixture consisting of red gum, hexamethylenetetramine, ammonium perchlorate, potassium perchlorate, and strontium carbonate. The effects of varying the ratios of these compounds were analyzed spectroscopically using a monochromator and related hardware. Emission data were analyzed and spectral features were assigned to emitting species.

Abstracts

GEOLOGY

ARCHIVAL RECORDS PERTAINING TO GEOLOGIC CONTROVERSIES IN CLAY COUNTY, ALABAMA. Lewis S. Dean, Geological Survey of Alabama, P. O. Box O, Tuscaloosa, AL 35486.

Archival records such as field notes, correspondence, newspapers, and county records can provide a great deal of information toward resolving geologic controversies. Two early investigations describing the geology and mineral resources of Clay County serve as an example. In the 1880's, published reports of tin deposits and mining operations near Ashland described an elaborate attempt to prove cassiterite-bearing biotite gneiss in high-grade metamorphic rocks (Mad Indian Group) of the Piedmont. The presence of tin deposits was frequently referenced to this mining operation. A reinvestigation of the geology and reported stanniferous mineralization [stratiform] utilizing archival records established the speculative nature of the mining operation and that the original reports of tin ore were unsubstantiated.

In 1903, a notice was published on the identification of plant cone fossils submitted to the Geological Survey of Alabama from Erin, a railroad station between Pyriton and Clairmont Springs. A well-preserved specimen was tentatively identified in 1903 by D. White as Lepidostrobus and was subsequently named (without a taxonomic description) by C. Butts in 1926 as "Lepidostrobus hobbsii, n. sp., D. W." This singular species was used to assign a Carboniferous age (Pennsylvanian ?) to a small section of the carbonaceous phyllites (Erin Slate Member of Lay Dam Formation) of the Talladega slate belt.

Subsequent geologic studies have discounted or accepted this age assignment and fossil occurrence, resulting in a long standing geologic controversy regarding the structural and stratigraphic significance of the Erin Slate. Numerous geologists have investigated the Erin area, including E. A. Smith, D. White and H. McCalley in 1903-05, W. F. Prouty in the 1910's, and C. Butts in the 1920's, none of whom collected specimens comparable to L. hobbsii. The collection and significance of L. hobbsii can best be evaluated using archival records at the Geological Survey of Alabama. In June 1903, Henry McCalley recorded in his field notes that he examined the "NE of NW of S 22, T 19 R 7 E. [where] the perfect cone seen at University [of Alabama] was found by Mr. [A. T.] Grogan's little boy in the hollow just to the NE of his house" [0.5 mi NE of Erin]. It was this loose specimen which came to the attention of Joshua Franklin (a resident of Erin) who mailed it to Eugene Allen Smith in 1902. The geologic significance of the fossil description overshadowed the lack of credibility related to the undocumented provenance, resulting in the use of a fossil specimen of unknown place of origin as paleontological evidence for age assignment of the Erin Slate. The supposition that the Erin was fossil-bearing did, however, lead to additional search and reports of fossil specimens recovered from the type locality, which support a Devonian (Tull et al., 1989, p. 342) or Mississippian age (Gastaldo et al., 1993, p. 633, 732-34).

WATER PROBLEMS IN THE CHOCTAWHATCHEE-PEA RIVERS WATERSHED IN SOUTHEAST ALABAMA. David C. Kopaska-Merkel and Marlon R. Cook, Geol. Survey of Alabama, PO Box O, Tuscaloosa AL 35486-9780.

The Choctawhatchee-Pea Rivers Watershed, which contains the cities of Troy, Dothan, Geneva, and Elba, among others, is characterized by a feast-or-famine hydrologic setting. The region receives an average of 56 inches of rain per year and suffers frequently from flooding. However, little of the surface water is readily available for use. The basin as a whole has more than sufficient ground-water resources, but even relatively small population centers are using ground water much faster than it is being recharged. For instance, public water-supply wells for the City of Dothan exhibiting long-term linear water-level declines will, if trends continue, fail to produce or lose producibility in about 50 years. Water wells in the basin with adequate spacing and rates of pumpage have maintained stable water levels for their entire periods of record (3 decades or more). However, areas of excess pumpage characterized by wells with declining water levels are found in all parts of the basin and in all aquifers. Localized, highly variable rainfall events cause the most severe flooding in portions of the major river, which receive the greatest rainfall. Recurrence intervals for major rainfall events are as short as ten years. The challenge will be to devise flood-protection practices and structures that target the most-likely events and that protect the most vulnerable areas. The water-supply problems, because they are primarily local, may be mitigated by tapping aquifers in places where they are relatively unused, and by siting wells sufficiently far apart so that local recharge can equal or exceed local withdrawal for the long term.

Abstracts

A PRELIMINARY DELINEATION OF THE WATER TABLE IN THE SURFICIAL AQUIFER, JONES VALLEY, JEFFERSON COUNTY, ALABAMA. Michael J. Neilson, Denny N. Bearce, Dept. of Geology, U.A.B., Birmingham, AL. 35294, and Stephanie A. Carter, ADEM, Montgomery, AL. 36109.

Jones Valley is part of the Birmingham-Big Canoe Valley physiographic district of the Alabama Valley and Ridge and is bounded to the northwest and southeast by Sand Mountain and Red Mountain, respectively. The valley is underlain by folded and faulted lower Paleozoic limestones and shales (Conasauga Formation) and dolomites (Ketona Dolomite and Knox Group). Groundwater in the surficial soils of above the carbonates is generally unconfined. Analysis of data contained in 79 individual contamination site reports submitted to the Alabama Department of Environmental Management by various geotechnical and environmental firms during the past 10 years shows: (i) the hydraulic conductivity of the surficial aquifer ranges over 3 orders of magnitude, from 2×10^{-4} to 4×10^{-7} ft/sec.; (ii) depth to the water table averages 10', ranges from 2 to 51', and does not vary significantly with underlying lithology (Kruskal-Wallis $H = 4.75$ $p = 0.192$); (iii) water table elevation is highly correlated with surface elevation ($R^2 = 0.914$); (iv) local depressions of water table elevations appear to be related to faults; and (v) a preliminary water table map shows northwesterly flow off the flanks of Red Mountain into the valley and a southwesterly to westerly flow in the lower reaches of the valley.

WATERMASS RELATED CHANGES IN THE SIZE DISTRIBUTION OF *NUTTALLIDES UMBONIFERA*. Murlene W. Clark and Dacia Jessick, Dept. of Geology & Geography, Univ. of South Ala., Mobile, AL 36688.

The size distribution of *Nuttallides umbonifera* was determined from four distinct Pliocene watermasses in the Lesser Antilles forearc region of the Atlantic basin, DSDP Leg 78A, Site 541. Specimens of *N. umbonifera* were found to be statistically smaller in diameter in cold watermasses of polar origin than in warmer watermasses formed during interglacial periods. *N. umbonifera* is a cosmopolitan abyssal species and the dominant assemblage component of populations under the influence of Antarctic Bottom Water (AABW) today. The size distribution of *N. umbonifera* was obtained from Pliocene samples associated with AABW, North Atlantic Deep Water (NADW), and two other watermasses believed to be of warmer interglacial origin dominated by *Globocassidulina subglobosa* and *Cibicides* spp. respectively. Specimens from the larger than 63 micron size fraction were examined to ensure that smaller size values in the size distribution were represented. Application of the statistical z test shows that populations of *N. umbonifera* associated with AABW and NADW have a 62% probability of being the same but the size distribution in warmer watermasses has much less than a 1% chance of being the same as that associated with either AABW or NADW.

Abstracts

PETROGRAPHIC ANALYSIS OF ARCHAEOLOGICAL ARTIFACTS FROM CLARKE COUNTY, SOUTH ALABAMA. Brad E. Franks, Douglas W. Haywick; Department of Geology and Geography. Read, N. Stowc, Department of Sociology and Anthropology, University of South Alabama, Mobile, AL 36688-0002

Manipulation of rock materials to create tools was an important function practiced by early cultures in order to improve their chances for survival. Artifacts of the tool making process can be found in Holocene sedimentary successions throughout the southeastern United States. Two such sites, the Dunning Agate Quarry and the McQuorquodale Reduction site, are located in west-central Clarke County, Alabama, near the Hatchetigbee Anticline and the Jackson Fault. Small flakes, cores and tools can be found at both sites, but they are particularly common at the Dunning Agate Quarry along the banks of a small incising stream. This study was initiated in early 1994 and is attempting to determine where the inhabitants of the area obtained lithic material to manufacture their tools. Here we present preliminary results of our petrographic analysis of eleven specimens collected from the two study sites. Surface artifacts and unaltered sub-surface materials from the Dunning site were compared petrographically for similarities. The McQuorquodale samples consisted of fractured microcrystalline quartz and chalcedony. Fractures were commonly lined with hematite. The Dunning samples were similar but contained few, if any, fractures, and were more prevalent in macrocrystalline grains of quartz and chalcedony. These samples show evidence of multi-generation pore-filling events. Microcrystalline quartz makes up most of the matrix. Pore-lining chalcedony was the first stage cement fill followed by macroscopic quartz. Late stage fracturing and hematite-fill are the last events completing the diagenetic history of samples collected at the two study sites. To say that Dunning Agate Quarry artifacts are by-products of subsurface materials would be premature to conclude at this time. Transportation of agate from other locations is equally feasible. Additional petrographic and geochemical analysis is presently underway to clarify the source of the agate.

PLIOCENE WATERMASS CHANGES IN THE ABYSSAL CARIBBEAN. Murlene W. Clark, Dept. of Geology & Geography, Univ. of South Ala., Mobile, AL 36688.

Pliocene changes in the Atlantic abyssal watermass structure have been detected through shifts in population dynamics of benthic foraminifers from DSDP Site 541, Leg 78A to the Lesser Antilles forearc region. Alternations between four distinct populations of benthic foraminifers occur between 1.77 and 3.66 Ma. These populations are recognised by shifts in dominance between *Nuttallides umbonifera*, *Epistominella exigua*, *Globocassidulina subglobosa* and a combined category of *Cibicides*. *N. umbonifera* is the dominant taxa in Antarctic Bottom Water (AABW) today and likewise dominated the abyssal population at Site 541 at 2.2 and 2.7 Ma and between 1.77 and 1.9 Ma. Shortened section is suggested between 2.2 and 2.4 Ma and may be the result of intense AABW flow. *Epistominella exigua*, presently associated with North Atlantic Deep Water, dominates the site at 2.6, 3.4 and 3.6 Ma. A fauna characterised by *Globocassidulina subglobosa* inhabits the area when polar watermasses are absent from the site. Elevated numbers of *Cibicides* occur at 3.5 Ma and indicate a fourth watermass possibly of Caribbean origin. Shifts in population dynamics among the dominant taxa indicate that a relatively warm climatic episode occurred between 3.6 and 2.7 Ma followed by an interval of climatic deterioration characterised by pulses of cold bottom water from both poles between 2.7 and 2.4 Ma. Full glacial development of both hemispheres probably occurred by 2.4 Ma.

Abstracts

MORPHOMETRIC VARIATION IN RECENT AND FOSSIL RIBBED MELANOPSIS (GASTROPODA) FROM ISRAEL. Rebecca Geist and Scott Brande, Dept. of Geology, UAB, Birmingham, AL 35294.

The freshwater gastropod, Melanopsis, is distributed widely from Asia to the Middle East, is found living abundantly in freshwater springs, ponds, and rivers, and is an important component of later Cenozoic invertebrate fossil communities in Israel. Extensive morphological variation is a hallmark of Melanopsis. Some previous workers have interpreted morphological variations of rib counts and shapes important enough to warrant creation of new specific taxa. We collected populations of Melanopsis throughout Israel, and borrowed samples from Hebrew University in Jerusalem for morphometric analysis of rib characters. Mean population values of rib counts, rib shapes, and form appear continuously variable among the populations we studied. We conclude, therefore, that rib characters cannot be used to justify new specific names. Others have suggested that rib development parallels energy of the environment (prominent ribs in higher energy, shallower waters of the Sea of Galilee, smooth shells in lower energy springs and ponds). No correlation occurs between the development of the ribs and the hydrologic energy of the environment in our collected populations. Mean population values of rib characters and form appear ordered by geographic region and age. This ordered pattern may represent regional differentiation controlled by isolation within drainage basins. (Thanks to M. J. Neilson, Dept. Chair, for financial support towards Brande's sabbatical, during which this project was begun; friends and colleagues in Israel facilitating sample collection: Eitan Tchernov, Yossi Heller, Henk Meinis, Steve Weiner, Na'ama Goren-Inbar, and students; and Gene Geist for extensive computer assistance.)

SEDIMENTOLOGY OF A MOBILE RIVER CUT BANK NEAR BUCKS, ALABAMA.

Kendall A. Rich and Douglas W. Haywick, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688-0002

The Mobile River cuts through a variety of Quaternary sedimentary units as it flows southward from its beginning at the confluence of the Alabama and Tombigbee Rivers. Near Bucks, Alabama, approximately 40 km north of Mobile, the Mobile River has exposed a 15 meter thick outcrop of Quaternary strata. In the summer of 1994, this outcrop formed the basis of an undergraduate sedimentology research project. In the field component of this study, two sections with vertical thickness of 12 meters and 9 meters were examined. Detailed measurements of lithology, sedimentary structures and faunal content were recorded. Thirty-two sediment samples were collected in order to determine grain size characteristics of the sedimentary sections. In addition, two thin-sections were produced in order to resolve the petrographic composition of the sand-sized sediment fraction. Based on the results of these field and laboratory data, detailed sedimentary sections of the outcrop were constructed which revealed two distinct lithostratigraphic facies. Facies A dominates the first 2 to 3 meters of each section and is composed of slightly silty mudstone with thin quartz-rich sand layers. The rest of the sections are dominated by Facies B; cross-stratified, quartz-rich, very-fine to medium sand with thinly bedded, slightly silty mudstone layers. Plant material, including leaves, seeds and rootlets are common throughout both facies, particularly Facies A. Limonite staining and sporadic cementation is more prevalent in Facies B. Facies A was probably deposited in a low energy bay-fill environment. Facies B is interpreted as a higher energy point bar deposited by a meandering river. The two facies represent a Holocene and/or Pleistocene equivalent to the present Mobile River/Delta environment.

Abstracts

NEWFOUNDLAND TO ALABAMA: EXTREME ENDS OF THE APPALACHIAN MOUNTAINS, SAME OLD DOLOMITE. Douglas W. Haywick, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688-0002.

Dolomitization is ubiquitous within Paleozoic carbonate strata throughout the Appalachian orogenic belt, including outcrops found at opposite ends of the mountain chain. In western Newfoundland (St. George Group) and central Alabama (Knox Group), similar multiple generations of dolomite can be identified. Both areas contain syngenetic dolostone, formed in tidal flat environments ("dololaminites"), early diagenetic dolostone, formed during groundwater infiltration, and late diagenetic dolostone, formed during tectonic deformation (faulting etc.). The Newfoundland study sites differs in one important way from the central Alabama site; they contain late stage epigenetic dolomite precipitated during brecciation and sphalerite mineralization. Stabilization of different generations of dolomite is also common in both study areas. Calcification ("dedolomitization") is particularly prevalent, and is of two main varieties: 1) zonal-specific, where one or more zones are selectively replaced, and 2) pervasive, where replacement is intense, but seemingly random. The timing of calcification at the two study areas is not entirely clear at this time, however, it may have coincided with tectonic deformation as much of the dedolomite is clearly spatially associated with faults and/or fractures. As with dolomitization, the method of calcification at the two study areas appears to be similar and involved fluids passing along fine fractures between 1 and 50 μm wide. In central Alabama, only one generation of calcification has been recognized to date. However, in western Newfoundland, three phases of calcite can be distinguished by their different luminescence properties and cross-cutting relationships. Here, the multiple phases of calcification has resulted in a "mosaic" appearance to the dedolomite when viewed under cathodoluminescence. This study was funded through the University of South Alabama Research Council and the Geological Research Account.

ROCK LITHIFICATION AT MAGNOLIA SPRINGS, BALDWIN COUNTY, ALABAMA. Dana L. Wolfe and Douglas W. Haywick, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688-0002

The town of Magnolia Springs is located in the Weeks Bay Watershed of Baldwin County, Alabama, some 20 km east-south-east of Mobile. Here, as in adjacent portions of the Coastal Plain, underlying Quaternary strata consist primarily of unconsolidated quartzose sand and gravel, silt and clay. Minor amounts of ferruginous cementation occurs throughout this portion of the Gulf Coast, however, in the Magnolia Springs area, cementation is more pervasive and in some cases, laterally extensive over several hundred square meters. In the vicinity of the Magnolia River, this cementation has resulted in a number of rocky ledges, some of which forms small waterfalls and rapids in the river's channel. Two generations of ferruginous cements are recognized: 1) isopachous limonite and 2) meniscus/isopachous hematite. Petrographically, cemented intervals are no different than unconsolidated sediments adjacent to the river. Cementation is, therefore, not controlled by grain size or porosity. Instead, cementation at Magnolia Springs is likely due to ground water percolation and flow-retardation over a imperious layers (aquicludes). The transition from limonite to hematite signifies a change in chemical environment from hydrolysis (limonite) to oxidation (hematite). This probably is related to the transition from phreatic to vadose diagenesis. Funding for this project was provided by a 1994 Weeks Bay Fellowship Award.

Abstracts

ACTINOSTROMATID STROMATOPOROIDS IN THE UPPER SILURIAN (PRIDOLI) FROM THE APPALACHIANS OF ALABAMA TO QUEBEC. Carl W. Stock, Department of Geology, University of Alabama, Tuscaloosa, AL 35487-0338.

Stromatoporoids in order Actinostromatida are defined as those in which the primary vertical skeletal structures are cylindrical pillars, and the primary horizontal skeletal structures are cylindrical rods, known as colliculi. Family Pseudolabechiidae contains genera in which pillars and colliculi are clustered into columns, regardless of their scale (e.g., *Pseudolabechia*, *Vikingia*, *Desmostroma*). Family Actinostromatidae includes genera in which the pillars and colliculi are large (e.g., *Actinostroma*, *Plectostroma*), and Family Actinostromellidae contains genera with skeletal structures of reduced scale (i.e., micropillars and microcolliculi) (e.g., *Actinostromella*, *Densastroma*); these internal structures are distributed evenly throughout the skeletons of the Actinostromatidae and Actinostromellidae. Actinostromatids are known from Alabama, Tennessee, Virginia, New York, and Quebec. Pope has reported *Actinostromella*, *Plectostroma*, and possibly *Densastroma* (as *Pycnodictyon*) from the West Point Formation of the Gaspé Peninsula of Quebec. Stearn and Hubert described *Densastroma* in the Ludlow-Pridoli-age Sayabec and St. Leon Formations west of Lake Matapedia, southeastern Quebec. Stock reported a species of *Plectostroma* from the Rondout Formation of New York that most likely represents a new genus, as well as a couple of species assigned to *Densastroma* that probably are part of a second new genus. In addition, a specimen of *Actinostromella* has recently been found in the Rondout of New York. One of the Rondout so-called *Densastroma* species has also been described by Stock and Holmes from the Keyser Formation of western Virginia; this species may also be present in the Sneedville Formation of northeastern Tennessee. In the Pridoli portion of the Red Mountain Formation near Birmingham, Alabama, a species that may belong to *Actinostromella* has been found.

STRUCTURE OF THE COOSA SYNCLINORIUM NEAR HARDWICK TUNNEL, ODENVILLE, ALABAMA. Denny N. Bearce, Dept. of Geology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

The Coosa synclinorium lies within the Southern Appalachian Valley and Ridge Province, and contains Paleozoic rocks transported northwestward on the Helena thrust fault exposed near Odenville, Alabama. The Helena thrust sheet is overridden from the southeast by other thrust sheets.

Exposures of the Upper Mississippian Parkwood Formation and the lower part of the Pennsylvanian Pottsville Formation immediately northeast and southwest of the Hardwick Tunnel on the Seaboard and Coastline Railroad reveal key stratigraphic and structural characteristics of the Coosa synclinorium. The Parkwood Formation, exposed northwest of the tunnel, is composed of interbedded fine-grained, thin-bedded sandstone and sandy siltstone, and is 300 to 400 feet thick. The lower Pottsville Formation, exposed above and immediately southeast of the tunnel, is comprised of two intervals of coarse-grained, pebbly, cross-bedded sandstone, each 150 to 200 feet thick, separated by approximately 300 feet of siltstone containing thin intervals of fine-grained sandstone and one interval about 6 feet thick of bioclastic limestone.

Folds and thrust faults in the Parkwood Formation northwest of the Hardwick tunnel verge southeastward, in contrast to the Helena fault. Most folds and thrust faults in the lower Pottsville Formation southeast of the tunnel verge northwest. Folds plunge gently east-northeastward, and are fault-propagation folds. Variation in vergence direction may reflect the geometry of a deeper fault, as it ascends from flat to flat via intervening ramps.

Abstracts

FORESTRY, GEOGRAPHY, CONSERVATION, AND PLANNING

LAND-USE CHANGE AND EFFECTS ON THE ENVIRONMENT OF RURAL AREAS AND URBAN FRINGES OF NIGERIA. Chukudi V. Izeogu, Dept. of Community Planning and Urban Studies, Alabama A&M University, Normal, AL 35762

Land-use change is a dynamic and evolutionary process which emanates from social, economic, political, institutional and technological factors. Pressures from land-use change processes result in many environmental, economic and social effects at local, regional and national levels. In Nigeria, the major land use changes which have occurred since the sixties, particularly in rural areas and urban fringes, are conversion of productive farmlands, forestlands, wetlands and pasturelands into urban and industrial uses. Statistical analysis of the relationship between land use change and a set of independent variables derived from social, economic and political factors indicates that population growth, urbanization, energy consumption and infrastructure development are the main factors underlying land use change in the country. In the Port Harcourt urban fringe and in some Ogbia-Egbema rural communities (Rivers State), land use changes have resulted in environmental effects such as disruption of ecosystem functions, loss of forests and land degradation. These effects, in turn, have generated adverse economic and social consequences including reduction of farm land per capita, continuous cropping on the same land, high land prices and land use conflicts. Minimizing these effects and enhancing productive use of land will require adoption of prudent land use management policies.

EXOSPORIUM ENCLOSURE OF PARASPORAL INCLUSIONS OF BACILLUS THURINGIENSIS. Kristin N. McDay and LaJoyce H. Debro, Department of Biology, Jacksonville State University, Jacksonville, AL 36265.

During sporulation Bacillus thuringiensis produces parasporal inclusions that are protoxins to selective insect larvae. In the case of the subspecies finitimus two inclusions are produced. The major inclusion appears early during sporulation and is formed within the exosporium with the spore. The minor inclusion appears later and is released into the environment separately from the spore. The exosporium bestows hydrophobicity upon the spore/inclusion mix as measured by percent transfer to hexadecane. The free inclusion remains in the aqueous phase while the enclosed inclusion/spore mix transfers to the organic phase. Hydrophobicity of the spore increases with age and simultaneously the enclosed inclusion is released to the environment. Outside the exosporium the inclusion loses its hydrophobicity and becomes susceptible to degradation. This work was supported by NSF Grant #MCB9250086 and NIH Grant #1R15GM49416-01A1 to LHD.

Abstracts

THE CASE FOR A SINGLE-PAYER, CANADIAN STYLE HEALTH PLAN.
Anis B. Salib, Department of Economics & Finance, Alabama
A&M University, Normal, Alabama 35762.

The purpose of this paper is to survey and evaluate the economic and welfare arguments for and against the single-payer health plan for the United States. Recent research on and discussion of health care reform have highlighted a number of concerns involved in a national choice, particularly universal coverage and cost control. Among the various questions addressed by current and proposed plans are (a) the role of the government in the financing and management of health care (a) the role of private insurance companies (c) the role of employers and (d) the extent and types of control to be imposed. The paper will concentrate on economic considerations and, to the extent possible, avoid the ethical and political aspects. The single-payer plan will be compared to the others from the point of view of its expected effects on incentives, on resource allocation and costs, and on the quality of product, as compared to other plans. Economic reasons for government interference will be considered mostly by comparison with economic reasons for government interference in other sectors or industries.

GLOBAL POSITIONING AND GEOGRAPHIC INFORMATION SYSTEMS AS CULTURAL
RESOURCE MANAGEMENT TOOLS AT FORT MCCLELLAN, ALABAMA. Robert T. Rice,
Directorate of Environment, Fort McClellan, AL 36205

The use of Global Positioning Systems (GPS) and Geographic Information Systems (GIS) can greatly enhance the management of cultural resources. At Fort McClellan these technologies are currently being utilized and allow instant access to accurate site locational and archaeological data. This permits post personnel to monitor possible impact to cultural resources that are the result of planned training exercises and proposed development. Through map layer manipulation environmental conditions and geologic processes can be viewed in relation to cultural manifestations to provide site probability estimations. This paper provides an overview of GPS/GIS technology and its applications at Fort McClellan. This research was supported in part by an appointment to the Research Participation Program at the U. S. Army Directorate of Environment, Fort McClellan, Alabama, administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U. S. Department of Energy and the U. S. Army.

Abstracts

GEOGRAPHY OF THE SIWA OASIS. David Icenogle, Dept. of Geography, Auburn University, Auburn, AL 36849.

The Siwa Oasis is located in the Egyptian Western Desert, 120 miles south of the Mediterranean Sea, and 40 miles east of the Libyan border. Although cool and pleasant during the winter, the Siwa Depression is excessively hot in summer, gaining temperature through adiabatic compression since it is 130 feet below sea level. The Siwan population constitutes an ethnic group quite distinct from the Egyptians. The Siwans are divided into the Easterners, who speak Arabic and belong to the Sunni sect, and the Westerners, who speak Berber and belong to the Sanussi sect. Siwans engage in a series of sequential marriages, rather than in polygynous ones. The agricultural economy is now largely commercial, with olives and dates as the main export crops. Wheat and the white potato are the chief subsistence crops. The area is still difficult of access and tourism is minimal. In antiquity Siwa was the site of the famous Oracle and Temple of Zeus Ammon, visited by Alexander the Great.

THE FERRY LAKE ANHYDRITE AND THE MOORINGSPOINT FORMATION OF SOUTHWEST ALABAMA. Dorothy E. Raymond, Geological Survey of Alabama, P.O. Box O, Tuscaloosa, AL 35486.

The Lower Cretaceous Ferry Lake Anhydrite is characterized by anhydrite beds in the subsurface of Baldwin, Mobile, southern Washington, and western Escambia Counties, Alabama. Where present, the anhydrite divides the updip undifferentiated Lower Cretaceous sequence into two units. Study of cuttings and electric logs from selected wells in the Ferry Lake and the overlying Mooringsport Formation indicates that the Ferry Lake generally thickens to the south and southwest by the addition of anhydrite beds. A local thin in the Ferry Lake over the Citronelle dome indicates salt movement at depth during deposition. The anhydrite was deposited in a lagoon partially restricted by a barrier reef to the southwest of Alabama. The Mooringsport thickens southward and in an east-west elongated area crossing north-central Mobile and Baldwin Counties. Southward displacement of depositional trends in the Mooringsport east of the Mobile graben indicates that rocks east of the graben are structurally higher than those west of the graben. Sediments of the Mooringsport include paralic and back-reef lagoon facies.

TOURISM PATHS OF ALABAMA. Tom L. Martinson, Dept. of Geography, Auburn Univ., Auburn, AL 36849.

Tourism paths, as expressions of the movement of people for recreational purposes, have been studied by geographers since ancient times. Today there are many examples in Alabama, most of them constructed by organizations, agencies, and individuals seeking to attract visitors to the state. Some state-scale tourism paths are introduced and analyzed.

Abstracts

GEOGRAPHIC IMPLICATIONS OF THE RECTANGULAR LAND SURVEY SYSTEM. Angelia L. Mance, South Dakota State University, Brookings, S.D. 57007.

The United States Rectangular Survey System is a striking ascendancy of geometry over physical geography. Originating over 200 years ago, the system is a record of the American frontier spirit blended with the concept of government for the people. But perhaps even more importantly, the survey system forever changed the cultural landscape of a nation.

This paper presents an overview of the early years of the survey system. Such elements as the rectilinear grid, the execution of surveying, contributions to mapping, and early opinions of the survey are discussed.

GREENING A DESERT IN OMAN AND THE UNITED ARAB EMIRATES. William R. Strong, Dept. of Geography, Univ. of North Alabama, Florence, AL 35632-0001.

For more than 20 years in the countries Oman and the United Arab Emirates, a considerable amount of planning and development has been focused on greening the arid landscapes. Using scarce water resources from the aquifers as well as desalination water from the Persian Gulf, an increasing amount of land has been connected by vast networks of tubes for drip irrigation. Economically important plants including the ubiquitous date palm, various vegetables, and alfalfa are being grown. For purely esthetic purposes, ornamentals have also been included in the planning and line the thoroughfares and park areas. This paper explores these developments and directions for the future.

COASTWISE TRADE AND THE DEVELOPMENT OF THE CALIFORNIA COASTAL COMMUNITIES. James T. Lima. Department of Political Science, Troy State University, Troy, AL 36082

Coastwise trade, the movement of goods between the seaports of a country, was an essential element to the development of California coastal communities in the era before the completion of the intra-state railway system. California has few natural ports which required coastal communities to rely on commercial wharves as ports of entry and exit for agricultural goods and other commodities. This paper examines the relationship between coastwise trade, commercial wharves and the development of the communities of Santa Barbara County and San Luis Obispo County, California, from the 1860s until 1910.

Abstracts

PHYSICS AND MATHEMATICS

FERMILAB EXPERIMENT E-871, SEARCH FOR CP VIOLATION IN Ξ^-/Ξ^+ and $\Lambda/\bar{\Lambda}$ HYPERON DECAYS. C. M. Jenkins & R. K. Clark for the E-871 Collaboration. Dept. of Physics, University of South Alabama, Mobile, Alabama, 36688.

Fermilab Experiment E-871 will search for further evidence for CP violation in the decays of Ξ^- (cascade hyperon: particle) and Ξ^+ (anti-cascade hyperon: anti-particle). CP violation has only been observed in the decays of one type of exotic particle/anti-particle system (the K^0 and $\bar{K}^0$) as a very small effect (at the approximately 0.2 % level). CP violation is believed to be the underlying reason that our Universe is composed primarily of matter and not equal quantities of matter and anti-matter. Because very little is known experimentally about CP violation, there are many theoretical models to explain the effect. More experimental evidence is needed to help the theoretical understanding of the phenomenon. The experiment will be searching for a very small differences in the angular distribution of the decay products of the Ξ^- and Ξ^+ decays. Any differences in the decay distribution will signal the presence of CP violation in this system. The sensitivity of the experiment (about 10^{-4} in a particular asymmetry) will require the total reconstruction of 4×10^9 decays. This experiment will begin data taking in 1996 at Fermi National Accelerator Laboratory. The University of South Alabama will be responsible for the construction and installation of the experiment's triggering detectors (that will send commands to record all detector contents to magnetic tape). This work supported by DoE 93 Contract #DE-FG05-ER40564

PARTICLE MOTION IN A CHARGED PSEUDO-NEWTONIAN GRAVITATIONAL FIELD. Govind K. Menon and John H. Young, Dept. of Physics, Univ. of Al. at B'ham, Birmingham, AL, 35294-1170.

Analysis of the motion of a charged (q), mass (m) due to the Newtonian gravitational field of a charged (Q) spherical mass (M) would not differ substantially from the classical Kepler problem. In essence, it would be necessary only to replace $-GMm$ in the Kepler problem by $-GMm + kqQ$, the value of k being determined by the choice of system of electromagnetic units. Motion considerations in the case of a pseudo-Newtonian field, formulated by including field energy densities as gravitational sources, lead to some interesting non-Newtonian features. Orbital and radial motions will be discussed, in particular. The latter case suggests the possibility of radial oscillations, a phenomenon having no Newtonian counterpart.

Abstracts

ROLE OF CRYSTALLIZATION PROCESS ON ELECTRICAL PROPERTIES OF POLYMER-BASED COMPOSITES. W. Wayne Yeh, Dept. of Physics, Tuskegee University, AL 36088.

Dc and ac electrical conduction properties have been investigated in four composites containing hydroxyl-terminated polybutadiene (HTPB) as binder and different proportions of aluminum particles as filler in a temperature range of -60°C to $+70^{\circ}\text{C}$ and a frequency range of 40 Hz to 100 kHz. The samples (HTPB+Al composites) used in this investigation are solid rocket propellant related materials. Electrical properties of solid rocket propellants are of concert because of the possibility of accidental ignition during manufacture and subsequent handling associated with lightning or electrostatic discharge. In this study, a change in conduction mechanism at a temperature of $4\pm 3^{\circ}\text{C}$ was displayed explicitly in dc measurements. The transition was shown to be due to crystallization of the HTPB upon cooling. DC conduction is explained in terms of ionic hopping in HTPB. Distinct polarization mechanisms, below and above the transition temperature, have been identified as interfacial polarization and electrode blocking effect, respectively. The change of conduction behaviors at the crystallization temperature, $4\pm 3^{\circ}\text{C}$, was not revealed explicitly in ac measurements. However, using the free volume concept to analyze the frequency shift factor a_T , a discontinuity in the fractional free volume curve was displayed. The temperature of the break point, 6.7°C , corresponds to the crystallization temperature of HTPB. The study showed that the crystallization of a polymer is accompanied by an abrupt reduction in free volume, and this structural change affects dc as well as ac conduction behaviors.

FINDING LINE INTERSECTIONS USING HOUGH TRANSFORMS: AN APPLICATION TO HIGH ENERGY PHYSICS. R. Kent Clark & C. M. Jenkins, Department of Physics, University of South Alabama, Mobile, AL 36688

The Hough Transform (HT) is a technique developed to find straight-line segments in imagery. It was originally used to find tracks in bubble chamber photographs and is now widely used to find lines and curves in digital imagery. The HT is still occasionally used in high energy physics to find tracks of particles passing through electronic detectors, but has begun to be forgotten as the bubble chamber has fallen into disuse. We will also show a new use for the HT to find the point of intersection of several lines. This makes the HT useful for finding event vertices. Using a monte carlo program, we simulated 1000 interactions of 800 GeV/c incident protons onto protons in a fixed target. Our Hough tracker found about 80% of the tracks in three dimensions and 99.5% of the event vertices. This work was supported by Department of Energy contract number DE-FG05-90ER40564.

Abstracts

COMPUTER ANIMATIONS IN PHYSICAL OPTICS. John T. Tarvin and Henry W. Glotfelty, Department of Physics, Samford University, Birmingham, AL 35229.

Students are often confused about the sense of rotation of the electric (and magnetic) field(s) in an electromagnetic traveling wave. Three computer programs that attempt to clarify the relationships between types of polarization and the direction of wave propagation have been developed. These programs run under the MS DOS operating system, and use color VGA animation of the electric-field vector to help student visualization of the motion. The programs are: 1) Traveling Wave: this program prompts for input of amplitudes and phases of the x- and y-components of the electric field and then animates the motion. Direction of propagation can be changed dynamically, as can the relative phase relationship between the E-field components. Vector tip-tracing and a pause feature provide easy visualization of plane, elliptical, and circular polarizations, and their relationship to relative phase. 2) Optical Activity: a plane wave is represented as two circularly-polarized waves with equal wave velocity. One can dynamically choose either l- or d-rotatory behavior and observe the effect on the rotation of the plane of polarization of the wave. 3) Birefringent Wave: a plane wave of user-selectable polarization is displayed; one can then observe the propagation of this wave through either a normal medium, a positive birefringent medium, or a negative birefringent medium. Conversion between plane and elliptical or circular polarization is clearly visible. All of the above programs are written in BASIC, and have been successfully run under a full-screen DOS session of Windows. Real-time demonstrations of these programs will be presented and discussed.

A COMPUTER SIMULATION STUDY OF RUTHERFORD SCATTERING. Jonathan Caro, John T. Tarvin, Henry W. Glotfelty, Department of Physics, Samford University, Birmingham, AL 35229.

Rutherford's model of atomic structure provides a mechanism for the calculation of the distribution of the scattering angles of alpha particles, in the form of a positively charged nucleus repelling the particles according to Coulomb's law. This distribution can be analytically calculated as a function of impact parameter if an inverse square electrostatic force law is assumed. A computer simulation of Rutherford's experiment has been developed. The effect on the angular distribution of varying the force law from its nominal inverse square value has been determined. Comparison of these various angular distributions allows one to determine the sensitivity of the scattering distributions on the power law.

Abstracts

A STUDY OF THE BLIZZARD OF 1993. Timothy A. Coleman, Henry W. Glotfelty, John T. Tarvin, Department of Physics, Samford University, Birmingham, AL 35229.

During March 12-14, 1993, one of the most powerful weather systems in recent U. S. history affected the eastern part of the country. This storm began to develop in the Gulf of Mexico, and as it intensified greatly and moved up the Atlantic coast of the U. S., it dumped huge amounts of snow, and produced high winds, thunderstorms, and coastal flooding. Birmingham, Alabama, for example received its record 24-hour snowfall from this storm, 13 inches. In order to understand the development of this powerful storm, one must understand the dynamic physical processes which were occurring as the storm evolved. Most of these processes can be studied through different areas of physics, including thermodynamics and fluid mechanics. In this talk, the specific physical processes responsible for initiating the development of the storm and intensifying it will be examined. Also, the physical processes involved in producing the devastating effects of the storm, such as the wind and snowfall, will be discussed.

THE UNA HOLLOW CATHODE EXPERIMENT*. A. Carnevali, Dept. of Physics and Earth Science, Univ. of N. Ala., Florence, AL 35632-0001.

A hollow cathode arc has been built and has recently become operational at UNA. Students have participated in all phases of the design, development, and testing of the apparatus. The arc operates in the pressure range from 150 mTorr to 2000 mTorr in Helium, with a pulse-forming network (PFN) supplying between 3500 V and 7500 V. Two discharge modes are observed: a low-current discharge ($I=100$ mA), which decays with a long time constant, and a fast, high-current "main" discharge ($I=250$ A), whose duration is determined by the PFN and is about 100 microseconds. The typical discharge starts in the low- I mode and switches to the high- I mode only if the pressure is above a narrow range around 230 mTorr. The time delay before the onset of the main discharge depends strongly on the gas pressure as well as the applied voltage. A detailed study of the discharge formation and evolution will be carried out in the coming year.

*Work supported by a UNA research grant.

Abstracts

THE INFLUENCE OF CHARGE IN A PSEUDO-NEWTONIAN GRAVITY. John H. Young and Govind K. Menon, Dept. of Physics, Univ. of Al. at Birmingham, Birmingham, AL 35294-1170.

Incorporating the mass-energy relationship into Newtonian gravity leads to an inclusion of field energy densities as source terms which supplement the usual Newtonian mass source. Such a modification of Newtonian gravity is referred to as a pseudo-Newtonian gravity, which is a non-linear field. In the case of the electromagnetic field, what results is a system of field equations reminiscent of, but much simpler than, the Einstein-Maxwell system of general relativity. The case of a spherical mass possessing a charge will be discussed and shown to give rise to a gravitational field having some distinctly non-Newtonian features.

INDUSTRY AND ECONOMICS

SOCIO-DEMOGRAPHIC IDENTIFICATION AND ENVIRONMENTALISM. Marsha D. Griffin and James G. Alexander, School of Business, Alabama A&M University, Normal, AL 35762.

In the Spring of 1994, 256 consumers were sampled to determine linkages between attitudes/behaviors toward environmentalism and selected socio-demographic variables. Overall, the most "environmentally correct" groups were middle aged, had a graduate degree, classified themselves as middle management, were affiliated with the Democratic party, were white, and were female. Those least environmentally correct were older, had attained at most a bachelor's degree, were lower-level white collar workers, were neither Democrats nor Republicans, were black, and were male. These rankings were determined by comparison of subgroup responses with responses of the survey population, with subgroup to population differentials cumulated to index measures. Females were much more likely to consider the effect of purchases on animals than were males and were also more likely to agree that the quality of the environment has decreased over the last decade and to choose retailers based on their environmental image. However, males were more likely to classify themselves as environmentalists, were more likely to agree that environmental protection is more important than economic growth, and were more likely to be active members of environmental protection groups (e.g., Sierra Club). Although blacks, as a group, were not as environmentally conscious as whites, they were more likely to agree that the quality of the environment has decreased and that the environment should be protected regardless of the cost. It is possible that this sentiment is a reflection of what some call environmental racism. Blacks were also more likely to have investigated car-pooling or public transportation than their white counterparts. The older respondents were more likely to classify themselves as environmentalists, were more likely to agree that one person's effort can make a difference, and were, surprisingly, more likely to be willing to pay 15% more for products/services because of environmental regulations. Further research, controlling for income, is needed on race and age.

Abstracts

THE NURTURE DEFICIT. James G. Alexander and Marsha D. Griffin, School of Business, Alabama A&M University, Normal, AL 35762.

One of the paramount problems of modern America is its nurture deficit--its underallocation of resources to the development of youth. Though many current public policy debates--such as welfare reform and federal budget balancing--are connected to this issue, they fail to address the problem head-on and are insufficient responses. Resistance to directly confronting the nurture problem concretely rather than symbolically reflects in part the intractability of the problem: it is very large and it is structurally complex. Thus, not only are major allocations necessary, but also there are potentially adverse behavioral effects on parents acting as instruments of implementation. Moreover, the ostensible youth-orientation of the U.S. (Pepsi comes to mind) suggests to many that youth are already well cared for if not pampered. The reality is otherwise. The actual youth nurture deficit has many dimensions, some of which lend themselves to quick statistical summary estimates: approximately 14 million poor, 500 thousand hungry, and 300 thousand homeless. Failure to provide for the young is recognized as a major contributor to a number of troubling social pathologies--e.g., crime, violence, and drug abuse. Slow economic growth, wage stagnation, family structure problems, cultural changes, and inadequate governmental policies have all had detrimental effects on the nation's nurturing. Unfortunately, censure is often easier than correct diagnosis, and preachments easier than problem-solving. Parents, blameful as they sometimes are, share both responsibility and results of inadequate nurture with society-at-large. Condemnation and/or punishment of the unwed teenage mother may be defensible public policy--but it does nothing to nurture her children. America's celebration of and crusade for freedom is inhibited by the fact that its jails hold a million prisoners. Closing of the nurture deficit would not eliminate crime and other social maladies, but evidence indicates that this is a necessary part of the solution. Enhance nurture as an act of compassion--yes; but also as an act of societal improvement.

DEVELOPMENT STRATEGY IN UNDERDEVELOPED COUNTRIES. V.R. Karumanchi, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762.

The end of cold war and the collapse of the former Soviet Union have some effects beyond its boundaries, mainly on developing countries. It is a false presumption to believe that the development policies applied in developed countries are directly applicable in underdeveloped countries. Disregarding this fact the international organizations, such as the World Bank seem to suggest and apply policies and strategies used in developed countries for underdeveloped countries, which may have adverse social and economic effects. In this article, I try to defend planning for an extensive growth and a more equitable distribution of income. In underdeveloped countries, some attempt must be made to provide for the necessities of the population at large support by an improved general living standard and welfare. It is not wise to create and stimulate the demands by only the upper income classes.

Abstracts

APPROACHES TO PRODUCTIVITY IMPROVEMENT. Samuel E. Dunu, Dept. of Business Administration, Alabama A & M Univ., Normal, AL 35762.

Productivity improvement is a continuous process. It is a never-ending quest. Even in the best run organizations, there is always room for improvement. The first task in any productivity improvement effort is to identify areas where improvement can be achieved. The areas must be specific and prioritized according to which ones hold promise for greatest gains. This requires a detailed and thorough appraisal of the goals, plans and activities of every aspect of the organization's operations, and the total environment within which it operates. The appraisal process can be organized around three areas; job-related, resource-related, and environment-related factors. Job-related factors include product and process design, work methods, quality, inventory, material handling and safety issues. These have important bearing on productivity. Resource-related factors include the organization's human resources, plants and equipments, technological know-how, capital and raw materials. The effective and efficient utilization of these resources have a major impact on an organization's productivity. Environment-related factors can be internal or external. Internal factors relate to the physical work environment, management styles, organizational factors such as size and structure. External factors include government regulations, political, social and economic conditions. After identifying areas for improvement, appropriate techniques to address the situation must then be chosen. Some of the techniques that may be used are; product quality improvement, employee empowerment programs, job enrichment, job rotation, incentive programs, just-in-time philosophy, technological innovations, employee training, value analysis, and preventive maintenance. These techniques are not mutually exclusive. In an organization, one or more of them may be used, either independently or jointly as is seen fit for the situation.

IS IT TIME TO EVALUATE COMMERCIAL NONPROFITS? Jane Wilson, Kerry P. Gatlin, and Keith Absher, Dept. of Marketing, University of North Alabama, Florence, Al 35631.

Nonprofit organizations make up a major economic force in the United States and they are among the fastest growing sectors of the economy. Their number has doubled since 1965 with approximately 1.2 million firms as of 1989. It has been estimated that the nonprofit sector produces roughly nine percent of our GNP. In the Northeast, the 100 largest nonprofit firms employ more people than the region's 100 leading industrial companies. Such economic clout, coupled with competitive advantages afforded nonprofits make them formidable competitors, especially for small profit seeking organizations.

Delegates to the 1986 White House Conference on small Business judged Commercial Nonprofit Enterprises to be the third most important concern of the small business sector followed by liability insurance and mandated employee benefits. This paper addresses the advantages of nonprofit status; the question of why nonprofit competition has become an issue; why nonprofits are given special privileges, the areas construed to be unfair competition and finally looks at possible solutions to the problem of unfair competition on the part of commercial nonprofits.

Abstracts

THE GROWING ROLE OF CHINA IN INTERNATIONAL TRADE: THE OPPORTUNITY AND CHALLENGE FOR THE UNITED STATES. Eric N. Rahimian and Yulong Ma, Dept. of Economics and Finance, Alabama A&M University, Normal AL, 35762.

Since 1978, China has embarked on economic reform and has made remarkable progress in transforming her centralized economy to a market-oriented economy. The growth of non-state enterprises has played a vital role in China's fast economic development. These enterprises constitute a major force in China's booming trade and account for 50% of her GDP in 1994. The low cost of labor and China's cultural links with overseas Chinese, mainly Hong Kong and Taiwan, have contributed to her export-oriented economy. In 1994, China's foreign trade reached \$235 billion with a \$5 billion surplus. Simultaneously, China had \$30 billion trade surplus with the U.S.. The U.S. has recently criticized the lack of strong corrective measures by China to protect the U.S. companies' intellectual property rights. In the meantime, the U.S. has not carefully examined the emerging opportunities for exports to and investment in China. Our analyses of the trade figures indicate that the two countries are complement of each other in productions and exchange. Although the China should take corrective measures in protection of property rights, the U.S. loss from this factor is only about \$1 billion per year. Therefore, the U.S. must face the challenge of reducing her trade deficit by taking advantage of investing in the needed areas of infrastructure in China.

USING MULTIMEDIA TOOLBOOK AND MICROSOFT PROJECT TO ENHANCE THE TEACHING OF PROJECT MANAGEMENT. Glenda Smallwood, T. Morris Jones, and Sarah R. Brown, University of North Alabama, Florence, AL 35632.

Often, the teaching of certain academic subject areas can be enhanced via the use of computer-based software. With the recent availability of multimedia authoring systems, teachers are now able to create their own tutorial software that will strengthen their courses.

At the University of North Alabama, the multimedia authoring system, Toolbook, has been used to create a Windows-based software tutorial that is being used by students together with Microsoft Project in management and accounting classes. Students in these classes are asked to complete an out-of-class assignment using Microsoft Project without extensive in-class instruction of the Microsoft Project software. Due to the complexity of Microsoft Project, an on-line tutorial is helpful for those students who are lacking computer and/or Windows software skills as well as those who wish to gain a more in-depth knowledge of Microsoft Project.

Abstracts

THE RELEVANCE OF RETAIL INDUSTRY SCAN DATA IN APPLIED CONSUMER DEMAND ANALYSIS. Chris I. Enyinda, Dept. of Business Administration, Alabama A & M University, Normal, AL 35762.

The generation of scan data via electronic scanner at the retail level provides the opportunities to conduct consumer demand analysis. Scan data are nontraditional and represent a new source of information about consumer demand. Traditional data bases used in demand analysis have been annual, quarterly, or monthly time series data of aggregated purchases and prices. These time-series data lack timely detailed market information about the consumer and are too general for application to retail demand analysis. Thus, retail industry scan data, which are records of individual sales to consumers over shorter time periods, are more appropriate for assessing consumer buying behavior. For the profit seeking retail firm, consumer demand analysis should be a vital part of business planning strategy, particularly in the highly competitive food retail industry. Consumer demand analysis is the estimation of the effects of variables that can affect product sales or purchase decisions. Accurate estimates of the effects of price, income, advertising, and demographic variables on consumer buying behavior can be a significant input to retail firm management decision-making. Those retail firms that examine how these variables affect consumer buying behavior may improve bottom line. Consumer demand analysis can increase the likelihood of successful business operations because it can provide retail industry with useful information about consumer demand in order to improve their decisions and to build better "consumer-driven retailing. Information derived from applied demand analysis can assist retail industry in becoming more responsive to changing wants and needs of consumers.

ENTERPRISE ZONES IN MISSISSIPPI: AN EMPIRICAL ANALYSIS. Jim F. Couch, Mark D. Foster, and Ashley Watkins, Dept. of Economics and Finance, University of North Alabama, Florence, AL 35630.

Enterprise zones were first established in Mississippi in 1983. Qualifying counties were given zone status and businesses were given tax incentives, such as income tax credits and capital gains tax exemptions, to locate within these zones. The purpose of these incentives was to create jobs and revitalize economically depressed areas. This model is intended to establish that these zones did aid the counties in creating new jobs. We estimate a model in which 1986 job creation in Mississippi's 82 counties serves as the dependent variable. Independent variables include the unemployment rate in 1986, the percentage of the workforce engaged in manufacturing in 1986, population per square mile, enterprise zone status in 1986, and average employee payroll in 1985. Those counties in which a larger percentage of the workforce is already engaged in manufacturing enjoyed greater job growth. More densely populated counties also experienced greater job creation. These results were expected a priori. The variable of chief interest, zone status, was positive and significant. Specifically, a county designated as a zone gained almost 150 more jobs over the year than other counties without zone designation. Our model explains nearly 30% of the variation of the dependent variable.

Abstracts

UNIVERSITY PURCHASING - A LINK TO THE LOCAL BUSINESS COMMUNITY. Gerald Crawford, Keith Absher, and Claude Hale. Department of Marketing, Management, and Computer Information Systems, University of North Alabama, Florence, AL 35632.

Unlike most businesses, a university has many publics with which it should develop mutually beneficial exchange relationships. One important secondary "public" that is commonly included in any real marketing analysis is the suppliers and vendors group, especially those in the local trade area. The chief contact point for this group is a university's purchasing department. In addition to the efficient (and legal) purchasing of goods and services required to operate a university, great care must be taken to deal with local businesspeople in such a way that they appreciate, and support all of the activities and programs sponsored by the school. A research effort was undertaken to learn how well the overall purchasing function was being handled at the University of North Alabama. A sample consisting of 131 suppliers was drawn from a population of 560 for interview. All interviews were conducted by senior level marketing students in 1994. Results showed that "fair and courteous" treatment was the norm and that UNA paid its suppliers "accurately and on-time." The overwhelming majority reported that the school strictly followed the State Bid Law. A few constructive open-ended comments were offered.

ALABAMA'S ISO AUDITING CONSORTIUM. Tom F. Griffin, III, Dept. of Information Systems/Decision Science, Auburn Univ. at Montgomery, Montgomery, AL 36117. Gerald Crawford, Marketing Dept., Univ. of North Alabama, Florence, AL 35632.

ISO 9000 (American National Standards Institute/American Society for Quality Control Q90-Q94) series represents an international standard for quality assurance systems. ISO 9000 establishes minimum requirements for quality assurance systems that may be used in contractual situations or non-contractual situations. For example, buyers may require suppliers to become registered to one of the ISO 9000 models as a condition of doing business. Other organizations may use the standard as a part of a continuous quality improvement program. The ISO Auditing Consortium, which meets alternately in Birmingham and Huntsville, provides free pre-registration audits for any organization interested in meeting the requirements of ISO 9000. The organization being audited pays only for expenses (transportation, food and lodging) of the auditors.

Abstracts

AVOIDING THE HYPERCRITICAL EFFECT IN COLLEGE CLASSES. Kerry P. Gatlin, Tammy Cooper, Julie McLemore, Patrick Colen, Karin Gielen, Kimball kraakman, Augustinus Van Vliet, and Gerald Crawford. Department of Marketing, Management, and Computer Information Systems, University of North Alabama, Florence, AL 35632.

Students systematically interviewed all 38 professors in the School of Business at the University of North Alabama to determine their "most favorite" and "least favorite" student related classroom behaviors. It was felt that this knowledge could possibly result in students achieving better grades by avoiding the hypercritical effect. A simple 1-5 weighting system was used to rank order a long list of behavioral characteristics. A separate write-in form was used to add unlisted items. The fifteen most desirable traits, in order, were: (1) Honesty, (2) A positive attitude, (3) A good listener, (4) High standards, (5) Good work habits, (6) Persistence, (7) Dependable, on time, (8) Enthusiastic, (9) Resourceful, (10) Good writing and speaking skills, (11) Open-mindedness, (12) Organized, (13) Flexible, (14) Good writing and speaking skills, and (15) Self-confident. The eight least desirable traits were: (1) Arriving late to class, (2) Unprepared for class, (3) Disruptive behavior, (4) Talking to others in class, (5) Sleeping in class, (6) No class participation, (7) Bad attitude, and (8) Unwillingness to try.

ANALYSIS OF INDUSTRIAL AND AGRICULTURAL PRODUCTION OF ETHIOPIA: POLICY RECOMMENDATION FOR ECONOMIC GROWTH. Fesseha Gebremikael and Eric N. Rahimian, Department of Economics and Finance, Alabama A&M University, Normal, AL 35762.

Agriculture is the linchpin of the Ethiopian economy, contributing 45 percent of the GDP and providing employment for 85 percent of the population. Our findings implicates that performance of Industrial and agricultural production over the last two decades has been not only disappointing but also marked by severe instability. As a result the exports volume is down, and industrial raw materials are insufficient. The combination of these constraints has reduced the rate of industrial and agricultural production. To overcome the existing industrial and agricultural production problem in Ethiopia, we have provided two recommendations:

(1) The Government must assume the economic leadership role and stimulate productive activities through well-managed and efficiently-run public enterprises.

(2) The Government should devote whatever resources it can to the rural and urban development. High priority areas include infrastructure and improving the methods of agricultural and industrial production.

Abstracts

TURKEY AT THE DAWN OF ECONOMIC GROWTH. Eric N. Rahimian and Yilmaz Esensoy, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762.

Despite the similarity of culture of Turkey and other middle eastern countries, Turkey is striving to distinct herself by developing a western-style economy which seems to be at the dawn of economic progress. First, we review the recent history of economic and political changes in Turkey. Then, we study the demographic as well as trade and financial statistics of Turkey to shed light on the current conditions. The third part deals with the recent economic development strategies of Turkey which include economic liberalization, investment incentives, and enhancing the exports and economic growth. Briefly, Turkey has a population of over 60 million and a GNP per capita of over \$2000, which in real terms is growing at 5 percent per year. The unemployment rate in Turkey is about 10 percent and income inequality is high. Nevertheless, Turkey has changed its policy direction from import substitution, market intervention, and reliance on state-enterprises to an export-oriented strategy. As a result, since 1980 Turkey's merchandize export has increased six folds and is still growing fast. Lastly, we analyze the economic trends of the Turkish economy and provide policy recommendations which may strengthen the support for industrialization and the movement toward a free market-oriented system. The recommendations include acceleration of privatization and improvement of the fiscal policy to strengthen provision of social services, education, and a more equitable distribution of income.

THE CONGRESSIONAL PAYRAISE: AN EMPIRICAL APPROACH. Carol Mayfield, Jason Thomas, Jim F. Couch, Department of Economics and Finance, University of North Alabama. Keith Atkinson, Department of Accounting Delta State University.

Although many votes taken in the House of Representatives are controversial, perhaps none was more so than the measure raising pay in 1989. A Representative voting in favor of the legislation risked antagonizing voters who were for the most part unhappy with the performance of politicians. In this paper we attempt to identify some characteristics of politicians that voted in favor of increasing salaries. We find that Democrats as well as those members living in districts with a greater cost-of-living as given by median home prices were more likely to support the measure.

Abstracts

ALUMNI AND UNIVERSITY PRODUCTS AND SERVICES MANAGEMENT. Tywana McClinton, Keith Absher, Gerald Crawford, Claude Hale, all are members of the Marketing, Management and Computer Information Systems Department, University of North Alabama, Florence, AL 35632-0001.

This study examined the "importance," to alumni, of products and services provided by the University and how well the University was "performing" (or delivering) these products and services. Data were plotted for both dimensions, importance and performance, on a four-quadrant matrix. Quadrant A shows University products and services that are important, but not offered at desired performance levels. From the alumni's perspective these include (1) admissions standards, (5) fine arts and cultural activities, (6) campus organizations, (7) social activities available, (9) job placement, (13) advising system, (14) faculty qualifications, (16) recreational activities, (17) faculty dedication to students and (18) quality of students. Quadrant B shows important services that the University is performing well. University administrators should strive to maintain the high level of performance on these factors. Quadrant B includes: (1) types of academic programs available, (3) intercollegiate athletics, (8) physical attractiveness of campus, (10) cost of attending school, (11) hospitality and friendliness, (12) reputation of school, (15) overall quality of education and (19) quality of academic programs. Quadrant C shows products or services that are being delivered in mediocre way, but are not very important to alumni. The alumni identified one product or service that came within these boundaries. This product is (4) intramural sports. Quadrant D shows a minor service that is being done in an excellent manner, a case of possible "overkill."

A RANKING OF COLLEGES BY THE SUPPLY OF DOCTORAL FACULTY TO ALABAMA COLLEGES. Uchenna N. Akpom, College of Business and Commerce, Livingston University, Livingston, AL 35470.

American colleges have been ranked in several ways for many years now. Previous rankings have emphasized research productivity of faculty and graduates, college competitiveness, and number of doctoral degrees awarded, among others. This paper presents a ranking of colleges in the United States on the basis of the supply of doctoral faculty to Alabama colleges. Location and ownership of the colleges are identified as important determinants of supply of doctoral faculty to Alabama.

Abstracts

OUT-MIGRATION AND ECONOMIC DEVELOPMENT: THE CASE OF BANGLADESH. Mohammad G. Robbani and Eric N. Rahimian, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762

The increasing magnitude and the impact of flow of migrant workers, mostly from the under-developed to the developed countries, have been widely discussed in the news media. In this paper, attempts have been made to discuss the implications of a large out-migration of workers from Bangladesh on its economic development. In 1987, approximately 75,000 workers were working temporarily in other countries and sent home about US\$617.4 million (net) in foreign currency. Since then, both the number of immigrants and the amount of remittances have grown considerably. This paper examines the recent trend of labor migration from Bangladesh and examines its impact on the employment, balance of payments and general economic growth of the country. A critical examination of this increasing trend of labor migration shows that it has been a mixed blessing for the economic development of the country. On one hand, it is reducing the unemployment level and is bringing additional foreign currency which is helps finance the country's export-oriented and developmental projects. On the other hand, because of the additional cash in the hands of consumers, it is fueling the inflationary pressure which is worsening the living standards of 85% of the population. Though it is widely believed that the foreign currency that is remitted by the immigrants is beneficial for an under-developed country like Bangladesh, cautious measures need to be taken about the outflow of skilled manpower and its adverse effects on the long-term economic growth of the country.

PERFORMANCE APPRAISAL - FAIRNESS AND ORGANIZATIONAL CITIZENSHIP BEHAVIOR. Henry M. Findley, Department of Marketing, Management, and Economics, Troy State University, Troy, AL 36082. William Giles, Auburn University, Auburn, AL 36849.

Fairness in performance appraisal was found to be predictive of organizational citizenship behavior over and above control variables and the quality of the supervisor-employee relationship. No moderator affects were found. The study found that structural aspects of the performance appraisal as well as the interaction between the supervisor and the employee in the appraisal process were important in predicting organizational citizenship behavior.

Abstracts

AN APPLICATION OF THE RELATIVE INCOME HYPOTHESIS TO THE U.S. DEFICIT. Uchenna Elike, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762.

Since 1980, America has been adding to its government budget deficit at an undefensible rate. The size of the deficit and its strong effect on interest rate, investment, and economic growth, has stifled the standards of living for this and future generations of Americans. This has generated intense concern among economists, corporate executives, and public officials. Generally, the government's tools to reduce the deficit are: (a) raising taxes, (b) cutting government spending, (c) inducing faster economic growth. The problem with the first two, however, is that they are legally and politically hard to implement. In addition, according to the Duesenbury's Relative Income Hypothesis, it is difficult to reduce government expenditures and hence the people's standard of living in the face of a deteriorating economy. In practice, this casts some doubt on a speedy deficit reduction through spending cuts. The Gramm-Rudman-Hollins Amendment of 1985 attests to this fact. Demographically, Americans are getting older and live longer after retirement. This phenomenon will reduce the tax base and revenues. Reviewing the official data, one finds that federal mandatory spending (entitlements and interest) which stood at 29.6% of total federal spending in 1963, grew to 61.4% in 1993, and is projected to climb to 72% by the year 2003. This leads to the belief that reducing the federal deficits and balancing the budget through tax increases or spending cuts will be difficult. However, applying several measures that can stimulate the economy may be useful. These measures include encouraging increases in the saving rate, conversion of defense technology into manufacturing and commercial use, and reduction of waste and inefficiency in government.

INFANT MORTALITY AND PUBLIC HEALTH. Nathan Allen, Suzanna Wylie, Jim F. Couch, Department of Economics and Finance, University of North Alabama.

Reducing Alabama's greater than average infant mortality rate is one of the state's goals. Government at all levels have established a number of agencies and programs that attempt to address this issue. In this paper we empirically investigate the notion that greater public health expenditures result in a reduction in the infant mortality rate. Holding other factor known to influence the rate constant, we find no validity for this assertion.

Abstracts

INTEGRATION OF ENVIRONMENTAL ISSUES INTO ALABAMA SCHOOLS OF BUSINESS. Marsha D. Griffin, Stacy Brown, and James G. Alexander, School of Business, Alabama A&M University, Normal, AL 35762.

During the Fall of 1994, environmental topics surveys were mailed to the deans/chairs of the business units of all Alabama higher education institutions. Environmental topics could include environmental management, marketing, economics, legal/public policy environmental issues, etc. Thirty-three usable questionnaires were returned, a response rate of almost 50%. Forty-eight percent of the respondents were affiliated with junior colleges, 29% with technical colleges, and 23% with senior colleges or universities. Over half of the respondents did not integrate environmental topics into the business program curriculum in any formal way (i.e., did not have a concentration/major, specific course, or unit in a course). Twelve percent offer a course on some type of environmental topic. Only 20% of the respondents reported that their business faculty members were doing any type of environmental research, with legal/public policy environmental topics receiving the most mention (9%). Ninety-four percent reported that no corporations had contacted the business school seeking students who have an understanding of both business and environmental issues. Only 29% of the respondents indicated that their business unit or institution had brought in any outside speakers to address environmental issues. None of the respondents had offered any seminar-type instruction on environmental topics. Although 38% said their faculty members view environmental topics as an important part of business students' studies, only 9% had spent any funds to purchase teaching material pertaining to environmental topics. Most of the respondents said their institutions encourage recycling, especially of aluminum cans, computer paper, and white paper, and 60% said their institutions use recycled products.

NEW DEAL, OLD PORK: AN ANALYSIS OF NEW DEAL EXPENDITURES IN ALABAMA. Jody Hanson and Jim F. Couch, Department of Economics and Finance, University of North Alabama.

Most observers argue that government spending during the New Deal was designed to promote recovery and help those displaced by the Great Depression. We test this hypothesis by examining the distribution of New Deal dollars across Alabama. Our results suggest that politics may have played a role in the allocation of funds across the state.

Abstracts

USING CASES AS A TEACHING TOOL. Tom Griffin, School of Business, Auburn University at Montgomery, Montgomery, AL 36117. Claude Hale, and Gerald Crawford, Department of Marketing, Management, and Computer Information Systems, University of North Alabama, Florence, AL 35632.

It has been shown that students learn more and retain material longer if they use the information or apply it in some way. The use of interactive cases in the classroom has been a widely used teaching method across many disciplines and is known to be an effective teaching tool. An exploratory research project was undertaken to learn why more professors do not use cases to teach business subjects. It was found that about 40 percent use cases at times, and another 40 percent use variations of cases or the case method. The disciplines of finance, marketing, management, and accounting seem to use case material most often. The quantitative and CIS/MIS areas use cases least often. The most often heard reason for not using cases was "too time consuming and too much effort required." One solution to the challenge of expanding the use of cases was the development of better and more comprehensive teaching notes by casewriters. A suggested teaching notes outline was presented that, if used, could reduce the time and effort required to prepare for and use cases in the college classroom.

PERFORMANCE MANAGEMENT MODEL. Henry M. Findley, Department of Marketing, Management, and Economics, Troy State University, Troy, AL 36082.

The performance management model provides an organized framework and reference for supervisors and managers to use in maintaining, and sustaining performance. The model integrates the current research on motivation. It is also consistent with U.S. laws and legal principles.

Abstracts

MEDIA SUPPORT AS A TOOL IN UNIVERSITY RECRUITING. Keith Absher, Gerald Crawford, and Claude Hale, Department of Marketing, Management, and Computer Information Systems, University of North Alabama, Florence, AL 35632.

Colleges and universities across America are finding themselves in very competitive situations. They must compete for students and resources without spending large amounts of public funds on marketing programs. One major avenue used to reach various groups (or "publics") with which mutually beneficial exchange relationships need to be maintained is publicity (or public relations.) Getting good media support, however, is no simple task. Media representatives from radio and television stations, and newspapers are not paid for running editorial stories and reporting news events. Therefore, getting them to run favorable (and frequent) news stories becomes the challenge. A study was conducted to learn what can be done to improve media coverage for the University of North Alabama. Thirty-eight media representatives in the University's primary service area were contacted in 1993. They ranked UNA highest among 11 schools served by the group. Many positive observations were noted. However, five concrete ideas were obtained that could result in more and better coverage. These have now been implemented.

ALABAMA COMMUNITIES OF THE SUBSISTENCE HOMESTEAD DIVISION. Mike Fugate, Ed Blackburn, and Jim F. Couch, Department of Economics and Finance, University of North Alabama.

Among the many programs of the New Deal was the Subsistence Homestead Division of the Department of the Interior. This agency attempted to move the masses of unemployed from large cities out into areas where some farming could be carried out. Planned communities were constructed, five of which were close to Birmingham, AL. This paper describes these communities and also gives some reason why such cooperative ventures are doomed to failure.

SCIENCE EDUCATION

RETIREMENT RESPONSE AMONG COLLEGE PROFESSORS TO THE LIFTING OF THE MANDATORY RETIREMENT CAP. Jerri H. Bullard, Dept. of Sociology, Univ. of N. Alabama, Florence, AL 35632. T. Morris Jones, Dept. of Management, Univ. of N. Alabama, 35632.

The mandatory retirement cap of age 70 for higher education in Alabama was lifted on January 31, 1993. The potential impact of such legislation is just now being realized by many institutions of higher learning. With shrinking enrollments, resulting from changing demographics, and increased expenditures for operations and deferred maintenance, many institutions are looking for ways to conserve funds and reduce overhead. The lifting of the retirement cap now opens the possibility that many institutions could become even more labor intensive. Without the mandatory retirement cap, colleges and universities could experience a "top heavy" faculty--one where the majority of professors have attained full professor rank and are paid accordingly. The prospect of facing an uncertain future has many institutions searching out creative ways to reduce costs and yet maintain a high quality product. Yet, are these concerns real? Few studies have been conducted to gauge the impact on faculty of the lifting of the retirement cap. The purpose of this paper is to examine the impact of the lifting of the retirement cap on faculty's plans for retirement. Analyses of survey results indicate that retirement plans or intentions have not been significantly affected by the removal of the mandatory retirement cap.

USE OF NOTEBOOK COMPUTERS IN PLACE OF TRADITIONAL STUDENT LABORATORY NOTEBOOKS. Thomas A. Ekman Dept. of Chemistry, Univ. of North Ala., Florence, AL 35632-0001.

Analytical chemistry laboratories in industry are becoming increasingly computerized. Local area networks (LANs) are often used to gather, process, and report analytical data and results. Several authors have suggested in the past few years that the traditional laboratory notebook will be supplanted in part or whole by electronic notebooks maintained on a computer. Therefore, students need to have some experience with computerized data acquisition, manipulation, and report writing. Because LANs are far too expensive for the average academic laboratory, notebook computers can be substituted. Electronic notebooks have been used successfully by senior instrumental analysis students using Macintosh PowerBooks, Microsoft Works, a simple analog-to-digital converter.

Abstracts

University and Community Partnerships in Science
Education, Elizabeth Rhodes Offutt
School of Education, Samford University, Birmingham, AL 35229

This presentation will focus on strategies to establish partnerships within the community for the purpose of enhancing science education.

Six Birmingham institutions joined together in an effort to help improve science education in the Birmingham Public elementary schools. This partnership was established because of the obvious need to provide stimulating early positive science experiences for K-3rd graders in the Birmingham Public Schools. The program is multifaceted and has a long term impact on the targeted students, teachers, and pre-service teachers. The partners in the effort are: the Birmingham Area Chamber of Commerce, the Applied Science Task Force, Birmingham Public Schools, the Samford University - Beeson School of Education, Birmingham Southern College, Southern Research Institute, and Discovery Place of Birmingham.

There are six objectives for science daze:

1. Help teachers overcome their fear of teaching science.
2. Familiarize teachers with resources available to them in the Birmingham science community.
3. Provide K-3rd grade students stimulating science experiences.
4. Distribute 30 proven hands-on science lessons to key science educators nationwide.
5. Provide proven, curriculum relevant hands-on lessons to teacher participants to improve their teaching ability.
6. Work with a targeted university teacher training program to provide requested support to better prepare their teacher candidates to teach K-3 science.

EXTRACTION AND FTIR ANALYSIS OF AGARITINE FROM MUSHROOMS - AN UNDERGRADUATE RESEARCH PROJECT. Jodi Adamson and Massimo D. Bezoari, Huntingdon College, Montgomery, AL 36106.

Undergraduate research projects provide students with experience in the process of scientific research. Students learn to carry out a comprehensive literature search, and participate in developing a plan for the project; they are exposed to laboratory methods that are not normally encountered in lab courses; they develop a field of knowledge which is not part of the regular curriculum; they learn how to plan and make a formal presentation of the project. Students also gain instrumentation experience, which is provided in this project by the use of an FTIR spectrometer interfaced to a computer (both funded by NSF Grant No. DUE-9450945 and Huntingdon College). While these are the purposes of the project, the project itself is directed to the isolation of a toxic natural product, agaritine, from mushrooms. Agaritine is a water-soluble amino acid, and, therefore, presents some difficulties in isolation. The goal is to simplify the isolation and purification process, and to analyze the compound by FTIR spectroscopy, in order to make the procedure suitable for incorporation into undergraduate organic chemistry laboratory courses.

WEATHER AND LIFE: AN INTEGRATED APPROACH TO SCIENCE EDUCATION (Meteorology). Paul J. Croft and Martin A. Tessmer, University of South Alabama, Mobile, AL 36688-0002.

The traditional approach to science instruction has centered on the teaching of disciplines of study in which students are exposed to a broad background of material which potentially has relevance to their lives. Unfortunately, students typically go through lower division science courses (which often address the discipline rather than the study involving the discipline itself) with a "get it out of the way" attitude and often fail to see the relevance of the topic to their personal or academic lives. For these and other reasons, undergraduate education in the sciences has generally been viewed as inefficient and unsuccessful in increasing or improving the student population's scientific literacy. This is a serious problem because in many situations these graduates will have to make personal and professional decisions based on their comprehension of scientific information (e.g., the interpretation of an environmental impact statement) and may arrive at incorrect conclusions because of their deficiencies in scientific understanding. In order to provide non-science majors with the background necessary to make informed decisions, provide science majors with the ethical implications and cultural contexts of their careers, and to help train future science teachers there must be an emphasis on the application of the sciences to real problems in basic research and in society. To accomplish this a multidisciplinary science topic such as meteorology (weather) may be used. Weather has a broad appeal because of its commonality of "hands-on" experience. Weather is an active learning environment which may be used as a resource to link the experience of science to concepts and quantification.

CLINICAL ANXETY DISORDERS: UTILITY OF SELF-REPORT MEASURES. Sheryl R. Jackson, Ph.D. and Natalie K. Martin, M.S., Dept. of Psychiatry and Behavioral Neurobiology, University of Alabama at Birmingham, Birmingham, AL 35294-0018.

The Minnesota Multiphasic Personality Inventory (MMPI) and the Millon Clinical Multiaxial Inventory-2 (MCMI-2) are two of the most widely used formal tests of personality employed by clinical psychologists. This study compares the clinical personality profiles of 14 anxiety disordered psychiatric inpatients and 14 psychiatric inpatient controls. Patients were matched for age, gender, race, and marital status. All patients met DSM-III-R diagnostic criteria for a psychiatric disorder and completed the MMPI and MCMI-2 as part of a comprehensive psychiatric evaluation. Results indicated that 71% of inpatients were accurately classified into psychiatric groups (anxiety vs. control) on the bases of the MMPI scale 3 (Hy; Hysteria) score alone. Anxiety disorder patients scored significantly higher ($M = 79$; $SD = 14$) than psychiatric inpatient controls ($M = 65$; $SD = 10$). In addition, anxiety disordered inpatients also scored significantly higher on scale 7 (Pt; Psychasthenia) and scale 1 (Hs; Hypochondriasis) scale. No other scale scores added significant information to correctly classify patients. The Anxiety scale of the MCMI-2 failed to differentiate among the anxiety disordered and psychiatric control inpatients. These results suggest a unique pattern of test profiles to alert evaluating clinicians to inquire about anxiety disorder symptoms.

Abstracts

IMPROVEMENT OF THE CHEMISTRY PROGRAM AT HUNTINGDON COLLEGE BY ACQUISITION OF AN NSF-FUNDED FTIR SPECTROMETER. Massimo D. Bezoari, Huntingdon College, Montgomery, AL 36106.

In Fall, 1994, the Department of Chemistry at Huntingdon College was awarded an NSF Grant (No. DUE-9450945), which was supplemented by the College, to acquire a Fourier Transform Infrared (FTIR) spectrometer interfaced to a 486 computer and color printer. This state-of-the art instrument enhances undergraduate science courses by providing students with hands-on experiences in spectroscopic analysis on the microscale level. The primary use of the instrument is in Organic and Instrumental laboratory courses. Students will study contemporary problems, including air pollution monitoring and analysis of commercial goods. Students also learn important computer-based methods of handling data, such as sensitivity enhancement, spectral overlay, quantitative analysis, and library searching and matching of spectra. Additionally, new material pertaining to FTIR analysis has been added to lecture courses, and mini-courses in FTIR analysis will be taught, e.g. in Jan-Term (interim term) classes.

High School Seniors Perspectives of Science. Robert E. Rowsey and Phillip McLarty, Curriculum and Teaching, Auburn University, AL 36849.

Three hundred and fifty-seven high school seniors within three weeks of graduation were given an assignment in their English classes to "define and explain what the word science means to you." The subjects represented high schools from three districts.

(1) Seventy four percent of the subjects described science in terms of product. Six percent described science in terms of process and twenty percent described science as a discipline constructed of products and process activity. (2) Twenty-two percent responded by describing science in biological terms. (3) Four percent of the students discussed science from a physical science perspective. (4) Seventy four percent of the students included biological and physical science notions in their explanation.

The science education community has proposed the importance of the process approach to teaching science for more than thirty years, both there is little evidence, gained from this limited study, that students understand the true nature of the scientific enterprise.

Abstracts

AN OVERVIEW OF THE ALABAMA SCIENCE IN MOTION PROGRAM.
John H. Young, Mike MacMahon, and Cindy Willingham,
University of Alabama at Birmingham.

In an effort to make modern laboratory equipment and opportunities available to high school students on a state-wide basis, legislation was passed which funded a program of scheduled deliveries of state-of-the-art equipment to the classroom. Fashioned after the highly successful program at Juniata College (PA), the Alabama Science in Motion program is overseen by the State Department of Education and operates through the efforts of seven universities throughout Alabama, targeting the areas of biology, chemistry, and physics. The program, past, present, and future, will be fully described by active participants in each of the basic science areas, and an opportunity will be provided for interested persons to examine equipped trucks in current use in the program's operation.

SHALL WE WAIT FOR THE MYRIAENNIUM? Ernest D. Riggsby,
Joseph D. George, Dutchie S. Riggsby, Columbus College,
Columbus, GA 31907-5645.

Our group noticed that the mass media has begun to emphasize the importance of the onset of the Third Millennium on our calendar and the articles and news releases constantly proffer the year 2000 as the date for that momentous event. We felt a need to devise a short unit for middle school science students to help them understand the connections between clock and calendar and we desired to correct the misconception about the actual date of the beginning of the new century and the Third Millennium. That year, of course, is 2001 and not 2000. We utilized both analog and digital time pieces and designed a workable (moveable) digital clock-calendar to further emphasize the relationship between and among various chronometric devices.

Abstracts

TIPS FOR TEACHING SCIENCE USING PRESENTATION TECHNOLOGY.
Dutchie S. Riggsby, Department of Instructional Technology,
Administration, and Foundations, Columbus College,
Columbus, GA 31907-5645.

And, just how do you compete with "television"? Of course, the seasoned teacher may not even try. For those of us who elect to leap into competition, teaching science is a natural springboard. There is so much to share in the form of photographs, diagrams, charts, graphs, sounds, and movies, that handling all the audiovisual devices could be a problem. With presentation technology, many of these problems are made simpler on the delivery end, though not less time consuming on the production or preparation side. From the inclusion of visuals within computer controlled programs, to the use of presentation packages to present information on a subject matter topic, there are many choices one can make that will permit creative control and instructional efficiency.

EXPERT SCIENCE TEACHING EDUCATIONAL
EVALUATION MODEL (ESTEEM) Judith A. Burry-Stock,
Educational Research, Univ of Alabama, Tuscaloosa, AL 35487

The Expert Science Teaching Educational Evaluation Model (ESTEEM) was developed to evaluate expert science teaching according to a combination of a constructivist and expert teaching philosophy. This perspective provides a sound theoretical basis for teaching and learning behaviors focusing on student-centered teaching that promotes meaningful, conceptual learning. ESTEEM is a professional development model to be administered by oneself, a peer, or an external evaluator. It houses five instruments designed to assess expert science teaching for both teaching practices and student outcomes and is currently being used for evaluating expert science teaching in many national projects.

LET'S NOT FORGET OUR GIFTED STUDENTS WITH LEARNING
DISABILITIES! Joseph D. Goerge, Ernest D. Riggsby, and
Dutchie S. Riggsby, Columbus College, Columbus, GA 31907-
5645. Teacher interactions with Learning Disabled Gifted
Students effect their performance dramatically. The
self-concepts of these children and their locus of control
orientations also play a role in their ability to learn in a
science classroom. Strategies for teaching these children
can overlap with those used to teach others although it is
important to examine each child's personal strhengths,
weaknesses, and emotional factors when working with him/her.

Abstracts

BEHAVIORAL AND SOCIAL SCIENCES

RACE AND THE SCI EXPERIENCE: STATUS OF THREE PSYCHOLOGICAL CONSTRUCTS. Melvin Davis, Belvia Matthews, J. Scott Richards, Warren Jackson, University of Alabama at Birmingham, Birmingham, AL, 35233-7330

This study explored the combined impact of disability and minority status on a measure of self-concept in community residing persons with spinal cord injury. Two potential mediating factors, hardiness, thought to be an important factor in a person's ability to respond to stress, and locus of control were investigated as well. Fifteen African American persons with spinal cord injury and 16 white persons with spinal cord injury as well as one each of their siblings were administered the Tennessee Self-Concept Scale, Rotter Locus of Control Scale, and the Personal Views Survey which measures hardiness. Spinal cord injured individuals were matched by neurological level and years post injury. Results revealed that the SCI respondents did not differ significantly from their siblings on measures of self-concept, locus of control, or hardiness. However, Caucasian SCI respondents displayed a more positive self-concept than did African American SCI respondents. This difference did not hold for their non-SCI siblings. That is, African American siblings displayed a self-concept that was not significantly lower than their Caucasian counterparts. The observed difference for SCI respondents on the self-concept scale prompted a sub-scale analysis. This analysis revealed racial differences for moral-ethical self, social self, satisfaction, and behavior. In each instance, Caucasian SCI respondents displayed a more positive self-concept. In the absence of pre-injury measures of self-concept, definitive conclusions cannot be drawn. Results of this study would suggest that SCI differentially negatively impacts African American individuals compared to white individuals. However, race is not an explanatory concept. Rather, studies such as this point to the need to explore what environmental and/or intrapersonal factors combine to make the process of coping with SCI seemingly more difficult for African Americans.

HEALTH-CARE REFORM AND THE ELDERLY. Harry G. Hamilton, Dept. of Sociology, Univ. of Ala. at Birmingham, Birmingham, AL 35294

The debate over the reform of our nation's health-care system has to date focused primarily on economic considerations and in so doing has diverted attention from other important social questions. Critical among these are questions about the care of our growing elderly population. What degree of responsibility are we as a society able and willing to assume regarding the well-being of our older citizens as we approach the next century? Who should have the right to what care, and under what conditions? The answers to these and related questions will depend in part on their underlying assumptions. It is the conclusion of this paper that such questions have not been at the center of the debate over health-care because of a prevailing ideology that promotes individualism, discourages collective solutions to social issues, and obscures understanding of the nature of reciprocity in relations between social groups.

Abstracts

LIFE EXPECTANCY OF VENTILATOR-DEPENDENT PERSONS WITH SPINAL CORD INJURIES. Michael J. DeVivo and Clarence S. Ivie, III. Department of Rehabilitation Medicine, University of Alabama at Birmingham, Birmingham, AL 35294.

Survival status of all 435 persons admitted to a model spinal cord injury care system between 1973 and 1992 who survived at least 24 hours postinjury and who were either ventilator-dependent at rehabilitation discharge or who died prior to discharge while still ventilator-dependent was determined as of December 31, 1993. Ventilator dependency was defined as requiring daily partial or total respiratory support. Causes of death were determined from hospital discharge summaries, death certificates, and autopsy reports. Statistical methods included life tables, proportional hazards regression and calculation of standardized mortality ratios comparing survival among ventilator-dependent persons with that of general population members of the same age, sex, and race. The overall one-year survival rate was 25.4%, while the 16-year survival rate was 16.8%. Among one-year survivors, cumulative survival over the next 14 years was 61%. Based on proportional hazards regression, mortality for persons injured since 1980 was reduced by 60% compared to persons injured between 1973 and 1979 ($p < .05$). Among one-year survivors, subsequent mortality was reduced by 39% for persons injured between 1980 and 1985, and 91% for persons injured since 1986, relative to persons injured between 1973 and 1979 ($p < .05$). Gender and race were not significant predictors of mortality among one-year survivors ($p < .05$). The leading cause of death was respiratory complications, particularly pneumonia. With development of improved methods of prevention and management of respiratory complications in this population, life expectancies should continue to improve. As a result, additional attention should be focused on enhancing quality of life of these individuals.

RELIGION IN NORTH ALABAMA: THE METHODIST EPISCOPAL CHURCH, SOUTH, 1924-1939. Kenneth R. Johnson. Dept. of History, Univ. of North Alabama, Florence, AL 35630.

This paper is the result of a project which involved the study of the North Alabama Conference of the Methodist Episcopal Church, South, during the 1920s and 1930s. During this time period the national economy changed from prosperity in the mid-1920s to the depths of depression in 1933, followed by gradual recovery. In many respects the Methodist Church followed this same pattern. The depress economic conditions and the decline in giving by church members brought on many cutbacks and short-term adjustment in church operations. But some parts of church life thrived, the depression notwithstanding. Church membership, adult and infant baptism, and numerous church programs--especially those involving youth and women--continued to grow and expand. This study was supported by a grant from the Research Committee of the University of North Alabama.

A COMPARISON OF HEALTHY ELDERLY ADULTS AND SUBJECTS WITH ALZHEIMER'S DISEASE ON SEMANTIC AND PHONEMIC GENERATIVE TASKS. Nancy B. Marshall, Department of Rehabilitation Medicine, Linda W. Duke, Departments of Psychology and Neurology, University of Alabama at Birmingham, Birmingham, AL 35233-7330.

Margolin and his colleagues (Margolin, Pate, Friedrich, and Elia, 1990) found that persons with Alzheimer's Disease demonstrated relatively poorer performance on the Boston Naming Test than on the Controlled Oral Word Association Test. This pattern of performance was interpreted to be indicative of greater impairment of semantic information processing relative to lexical-phonological information processing during the early stages of the disease process. This study was designed to test several alternative hypotheses. A comparison of semantic versus phonemic information processing abilities in healthy older adults and in adults with Alzheimer's Disease was made employing two tasks which (1) both impose the same time limitations on subjects; (2) both require generative recall abilities; and (3) both have similar administration and scoring criteria. The two measures chosen were the Controlled Oral Word Association Test (Phonemic Fluency Test) which is purported to tap lexical-phonological processing primarily and the Grocerystore Verbal Fluency Test (Semantic Fluency Test) which is purported to tap semantic processing primarily. Both within-group and between-group performance of adults with Alzheimer's Disease and healthy older adults over a three year period was investigated. Findings are discussed relative to the dissociation effects of Alzheimer's disease on semantic versus lexical-phonological generative naming abilities. Acknowledgements. This research was supported by a pilot project grant from the NIH/NIA (P01AG10163) to the first and second authors and a National Research Service Award from the NICHD/NCMR (T32HD07420-04) to the first author. We thank James Flege for the use of his laboratory facilities. The first author extends appreciation to Scott Richards for his support.

THE EFFECTS OF AGE AND ALZHEIMER'S DISEASE ON RECOGNITION OF GATED SPOKEN WORDS. Nancy B. Marshall, Department of Rehabilitation Medicine, Linda W. Duke, Departments of Psychology and Neurology, Amanda C. Walley, Department of Psychology, University of Alabama at Birmingham, Birmingham, AL 35233-7330.

This study investigated the effects of Alzheimer's disease and normal aging on ability to recognize spoken words. Groups of healthy young adults, healthy older adults, and adult with Alzheimer's disease were presented spoken words and with and without semantic primes. Theoretical predictions of the Cohort model of spoken word recognition (Marslen-Wilson, 1984) and Hasher and Zacks' (1979) postulates regarding automaticity were tested employing both between-group and within-group comparisons. The results are interpreted in relation to the theoretical predictions and the findings of previous gating studies. Acknowledgements. This research was supported by a pilot project grant from the NIH/NIA (P01AG10163) to the first and second authors and a National Research Service Award from the NICHD/NCMR (T32HD07420-04) to the first author. We thank James Flege for the use of his laboratory facilities. The first author extends appreciation to Scott Richards for his support.

Abstracts

Differences in computer users' stress and self-concept in college personnel and students. Richard A. Hudiburg, University of North Alabama, Florence, AL and James R. Necessary, Ball State University, Muncie, IN

The psychological impact of human-computer interactions has been the focus of numerous research investigations. One such psychological impact is computer-related stress and stress related reactions, such as somatization and anxiety. There has been very little investigation of the relationship between personality variables and the psychological impact of computers, such as computer users' stress. The current study investigated the relationship between computer users' stress and self-concept, an important aspect of personality functioning.

Samples of college students ($N=104$) and college faculty/staff ($N=88$) at a midwestern university completed a questionnaire composed of the Computer Hassles Scale, a measure of computer users' stress, somatization/anxiety items from the SCL-90, a measure of stress reactions, and the Revised Personal Attribute Inventory, a measure of self-concept. Correlation analyses showed that for students there was a significant negative relationship between computer users' stress and self-concept ($r = -.30$), while for faculty/staff there was a significant positive relationship ($r = .28$).

The difference in the direction of the relationship might be explained by the nature of the computer task outcomes. Students' computer use is primarily a directed activity based on a course assignment which will ultimately be evaluated for a grade. On the other hand, faculty/staff's computer use is a less directed assignment and may have only a remote relationship to an evaluation. There is a need for further investigations of relationships between computer use and personality.

INFLUENCE SOURCES FOR NURSING LEADERS: WHERE DOES MENTORING FIT?
Judy D. Short, RN, DSN, Eastern Ky. Univ., Dept. of Bacc. Nursing,
Richmond, KY 40475.

A study examining sources of influence for goal achievement was conducted using a sample consisting of the 324 deans/directors of the 441 American Association of Colleges of Nursing member schools of nursing who completed and returned the mailed questionnaire. The findings indicate that mentoring is of lesser importance for this group than was found with earlier research using different groups of subjects. The number one ranked resource for goal achievement was communication skills. Thinking and relating types of skills were found to be more important than mentoring, work positions, professional organization positions, awards, personal traits, or networking and support as sources of influence for goal achievement. Personal characteristics, career characteristics, and influence activities were also described. The study was conducted while the author was a doctoral candidate at the University of Alabama School of Nursing, University of Alabama at Birmingham.

Abstracts

COMPROMISED RELIABILITY IN NONSTANDARD ADMINISTRATION OF COMMONLY-USED SELF-REPORT MEASURES AMONG REHABILITATION INPATIENTS. Warren T. Jackson, Dept. of Rehabilitation Medicine, Univ. of Ala., Birmingham, AL 35233.

The reliability of paper-and-pencil self-report questionnaires is of utmost importance in the measurement of psychological variables. Use of self-report measures is a particular challenge with individuals who have cognitive impairment due to brain damage or sensory compromise associated with normal aging. Seventy rehabilitation inpatients undergoing psychological screening for participation in a treatment study were administered five commonly-used self-report measures: (a) Center for Epidemiological Studies-Depression Scale, (b) Wahler Physical Symptoms Inventory, (c) Marlowe-Crowne Social Desirability Scale, (d) State-Trait Anxiety Inventory, and (e) the Multidimensional Health Locus of Control Scales. Standard administration was modified to maximize reading comprehension by enlarging (11 x 14 inches) scale rating anchors and affixing them to poster board in a vertical orientation. A standardized orientation to each self-report measure response poster, the standard directions (adapted for oral administration), and all self-report items were read aloud to the subjects exactly as they were written and in the correct order. Each subject was instructed to indicate responses via speech, gesture, or head nod. Results of reliability analysis revealed compromised mean internal consistency coefficients: .74 for patients with right-hemisphere brain dysfunction, .66 for patients with left-hemisphere dysfunction, and .50 for orthopedic/medical patients. Caution is needed in interpreting the data obtained from nonstandard administration of self-report measures.

DEVELOPMENT OF GUN CONTROL ATTITUDES. Robert G. Riedel, Jr., Dept. of Psychology, Troy State Univ., Troy, AL 36082

College students' development of gun control attitudes was explored between gender, experience with fire arms, and whether they grew up in an urban or rural setting. Specifically, one thousand five hundred and eighty students were asked to fill out a questionnaire developed to assess attitudes toward gun control. Based on the scores from the questionnaire 2 groups (those opposed to and those favoring gun control) were identified. Results from the survey, revealed that overall women were significantly more favorable towards gun control than men. However, when experience with fire arms was factored out the gender difference was eliminated. Finally, subjects with an urban background were more favorable towards gun control than subjects with rural backgrounds and subjects from rural backgrounds also had significantly more experience with fire arms than urban subjects. It is concluded that experience with fire arms may play a significant role in the cognitive development of our attitudes toward gun control rather than gender per se.

Abstracts

CAREGIVERS OF PERSONS WITH SPINAL CORD INJURY: A LONGITUDINAL INVESTIGATION. J. Scott Richards, Richard Shewchuk, Timothy R. Elliott, Julie Bullard, University of Alabama at Birmingham, Birmingham, AL 35233-7330.

The mental and physical health of a person with a spinal cord injury (SCI) are dependent in many cases on the caregiver. However, little is known about the impact of the care process on the caregiver. We have begun a multi-wave longitudinal study of the mental and physical health of caregivers of persons with SCI over the first year postdischarge. This is a longitudinal study with repeat administration of a questionnaire to the caregiver during rehabilitation (T_1), one month postdischarge (T_2), six months and one year postdischarge (T_3 and T_4). Preliminary results of a initial sample size of 30 will be presented; in most cases, small sample size precludes a finding of statistical significance. Trends in the data will be described. Ninety percent of caregivers are female contrasted with 87.5% of the spinal cord injured individuals being male. Fifty two and a half percent of caregivers were working full- or part-time at T_1 and 50% remain employed at least part-time by T_2 , and report a reduction in help from family members and friends both in care of the person with SCI and household chores from T_1 to T_2 . The caregivers also demonstrate increases in depression, decreases in positive affect, increases in state anxiety and increased numbers of physical symptoms over time. At the same time a modest reduction in perceived distress of the person with SCI is reported. As sample size increases, more statistically rigorous comparisons will be completed and the mental and physical health of the caregiver correlated with physical health outcomes of the person with SCI.

CRIME IN HEALTH CARE: AN OVERVIEW. Brian K. Payne, Dept. of Criminal Justice, Troy State Univ., Troy, AL 36082. Dean Dabney, Dept. of Sociology, Univ. of Florida, Gainesville, FL 32611. Pierce Joseph Harper, Dept. of Criminal Justice, Troy State Univ., Troy, AL 36082.

The health care industry is one of the largest employers in the United States. The actions of the employees have been examined in great detail in the past. What is scarce in the literature, however, is an examination of the kinds of deviant acts committed by health care professionals during the course of their daily occupational routines. This paper, from a holistic perspective, examines deviance in the following health care occupations: hospitals, doctors' offices, nursing homes, and pharmacies. The kinds of deviance acts to be examined include Medicaid fraud, prescription fraud by pharmacists, drug abuse by pharmacists, and patient abuse in nursing homes. Implications for future research and policy are provided.

Abstracts

CRIMINOLOGICAL CONCEPTIONS OF PUNITIVE DAMAGES: A GUIDELINES APPROACH TO THE DETERRENCE OF CIVIL WRONGDOING. Edward H. Stevens and Brian K. Payne, Dept. of Criminal Justice, Troy State Univ., Troy, AL 36082.

Parallels and anomalies exist between recent developments in criminal sentencing reform and the imposition of "skyrocketing" punitive damages in civil litigation. Recent decades have seen attempts to sustain legitimacy in both federal and state criminal sentences by reducing judicial discretion. Through the development and implementation of sentencing guidelines, Congress and many state legislatures have attempted to equalize punishments across jurisdictions by prescribing and promulgating appropriate sentences for specific crimes. At the same time, however, tremendous debate has been generated by the apparently unbridled discretion which the Supreme Court has found constitutionally acceptable when punitive damages are awarded by civil juries. This paper examines the way that theoretical developments in the criminal context can help to fashion a workable method of awarding appropriate punitive damages. After reviewing deterrence theory and recent Supreme Court cases dealing with excessive punitive damages, a guidelines approach to control excessive jury awards will be suggested.

PREDICTORS OF COMPLIANCE WITH ANNUAL FOLLOW-UP IN PERSONS WITH SPINAL CORD INJURY. Kay C. Canupp, Ken B. Waites, Michael J. DeVivo, and J. Scott Richards, Univ. of AL at Birmingham, Birmingham, AL 35233.

A significant number of spinal cord injured (SCI) persons fail to return for regularly scheduled evaluations. A prospective study of SCI persons was performed to determine why they fail to return for scheduled evaluations following injury, to develop a predictive model to target those at greatest risk for non-compliance, and pave the way for future programs designed to increase rates of return. We located subjects who had not returned for annual follow-up for a period between 3 and 15 years and paid them to come in for evaluation and comparison with controls who are evaluated on an annual basis. We enrolled 59 subjects and 91 controls. Pearson chisquare showed no difference between the groups according to gender, race, level of injury, completeness of injury, educational level, or etiology of injury. All patients were administered a psychological questionnaire of theoretically driven variables and scales and a number of socioeconomic variables. There was no significant difference based on the health locus of control or perceived vulnerability scales. Both groups were asked to identify obstacles to returning. For subjects and controls, respectively, cost was identified as a problem 48% and 18%, distance 31% and 13%, transportation 27% and 12%, follow-up not necessary 25% and 0%, good local doctor 17% and 0%, and time 10% and 25%. These data indicate a need to improve our educational efforts for new SCI patients on the need for follow-up, to maintain close contact post-discharge, and to assist them in identifying resources within their communities to facilitate compliance with planned evaluations or develop acceptable alternatives.

Abstracts

THE EFFECT OF RECIDIVISM ON THE SENTENCING OUTCOMES FOR FEMALE RECIDIVISTS. Charles O. Ochie, Sr., Dept. of Criminal Justice and Sociology, Troy State Univ., Troy 36082.

The current literature suggests that while about half of female inmates have been previously sentenced to incarceration or probation at least twice, more than one third have been previously incarcerated three times or more. This paper examines the impact this trend has on the sentencing outcomes for female recidivists. A total of 2,343 females serving sentences between 1 to 60 years in Oklahoma in four selected years were examined according to three levels of recidivism. Offenses were analyzed in three categories: violent, non-violent and drug-related. Analysis of Variance was used to ascertain the average sentence length of these offenders according the average sentence length of these offenders according the three levels of recidivism. Analysis reveals that females convicted of repeat offenses received an average longer sentence than the one assessed on their previous conviction. In both violent, non-violent and drug-related categories, female recidivists were sentenced longer in almost each level of recidivism. This finding reflects a relationship between female recidivism and sentencing outcomes.

SANTERIA RELIGION: FREE TO EXERCISE. C. Marcel Stoetzel III, Dept of Political Science, Univ. of South Alabama, Mobile, AL 36688.

During the 1992 - 1993 term the Supreme Court considered the case of The Church of The Lukumi Babalu Aye v. Hialeah, 113 S. CT. 2217. At issue was the Free Exercise of Religion clause of the First Amendment to the U.S. Constitution. The city of Hialeah, Florida, passed several ordinances in the name of public health and welfare placing limitations on the ritual slaughtering of animals as practiced by members of the Santeria religion. The Supreme Court's examination of the ordinances, probed for governmental interest and delved into what was neutral and fair for all. In so doing, the Court established a building block of criteria that must be considered in future situations concerning religious freedoms.

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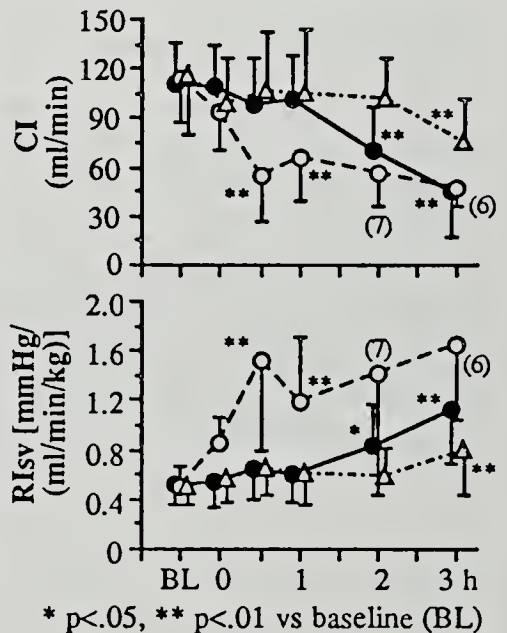
A PRELIMINARY ANALYSIS OF CORRECTIONAL EXECUTIVES' MANAGEMENT STYLES. Jerald C. Burns, Department of Criminology and Criminal Justice, Alabama State University, Montgomery, Alabama 36101.

The purpose of this research paper is to present the preliminary results of a nation-wide survey on management styles administered to the 50 state correctional commissioners, directors or secretaries, as well as the District of Columbia and the Federal Bureau of Prisons. A review of the literature presents a confusing picture of what management styles appear to be favored i.e., autocratic, democratic or laissez-faire. Further, it is important to assess individual management philosophies or styles versus policy choices. Preliminary results are assessed using descriptive and inferential statistics as well as some demographic data.

HEALTH SCIENCES

ROLE OF NITRIC OXIDE (NO) IN HEMODYNAMIC CHANGES IN NEWBORN PIGLETS WITH ENDOTOXIC SHOCK (ES). Joseph B. Philips, III, James R. Oliver, Jia-Xian Li. Departments of Pediatrics, and Physiology and Biophysics, Univ. of Alabama at Birmingham, Birmingham, AL 35233.

Unregulated release of large amounts of NO is thought to cause the vasodilation and hypotension seen with the hyperdynamic form of ES in adults. It is unclear whether NO release also increases in the hypodynamic ES often noted in newborns. To ascertain the role of NO in neonatal ES, we studied the effects of pretreatment with 5 mg/kg of N^G-nitro-L-arginine methyl-ester (L-NAME), a NO synthase inhibitor, 15 min before endotoxin (Group LE, ○, n=8), or L-NAME plus 0.2-0.4 mg/kg/h of nitroprusside, a NO donor, (Group LNE, Δ, n=8), or 20 μg/kg/h of endotoxin alone (Group E, ●, n=8) in acutely instrumented newborn piglets. Endotoxin infusion caused hypodynamic shock characterized by lowered cardiac index (CI) and increased systemic (RIsv) and pulmonary (RIpv) vascular resistance indexes. Systemic artery pressure (Psa) was stable until 2 h and then decreased somewhat. 6 of 8 LE animals developed hypertension; 2 developed severe hypotension and died within 3 h. CI was lower, while RIsv and RIpv were higher in the LE group than in the other 2 groups. No significant differences were noted between groups E and LNE except for CI, which was higher in the LNE group at 2 and 3 h. Results suggest that there was not a large increase in NO release in our ES model. In fact, inhibition of NO production induced vascular constriction and aggravated the shock syndrome, indicating that NO inhibition alone may be detrimental in neonatal ES.



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SYNTHESIS OF POTENTIAL ANTI-TRYPANOSOMAL AGENTS. Charles L. Newton and Julio F. Turrens, Department of Biomedical Sciences, University of South Alabama, Mobile, AL 36688-0002

The metabolic differences between parasites and hosts may be targets for drug development, particularly for intracellular parasites which are protected from the hosts immune response (i.e., *Trypanosoma cruzi*). The enzyme NADH-fumarate reductase (FR) is present in *Trypanosoma brucei* procyclic trypomastigotes and all forms of *T. cruzi*, but not in mammalian cells. We identified two FR inhibitors (L-341,828 and L-092,201 originally designed by Merck, Sharp and Dohme labs. against other parasites) that inhibit the enzyme from *T. brucei* but are no longer available. An attempt was made to synthesize both compounds. The products were analyzed using nuclear magnetic resonance (NMR), mass spectrometry (fast atom bombardment, FAB), and measuring melting points. L-341,828 was successfully synthesized as indicated by the presence of a FAB peak corresponding to its molecular weight, a melting point of 300-305 °C and through NMR. An attempt to synthesize L-092,201 was unsuccessful. However, one of the reagents (mercaptopyridine N-oxide, MPNO) turned out to be also a potent FR inhibitor. The ID₅₀ for L-341,828 and MPNO were 5 and 3 µg/ml, respectively. These drugs were tested on several mammalian NADH- and succinate-dependent activities, including NADH-cytochrome *c* reductase, succinate-cytochrome *c* reductase and lactic dehydrogenase. The effect of both drugs on these mammalian enzymatic activities was minimal. This suggests that these drugs may be selectively toxic against the forms of FR found in trypanosomatids. All drugs were also tested on *T. brucei* procyclic trypomastigotes in culture. These drugs inhibited cell growth in culture at concentrations that inhibited FR activity. Since both MPNO and its derivative L-092,201 as well as NADH (the enzyme substrate) contain a pyridine ring, we propose that these drugs may interfere with substrate binding. (Supported by PHS #1R15 AI 32703-01 TMP).

ELDERLY PERCEPTIONS OF NUTRITION AND EXERCISE. Portia Foster, College of Nursing, Jacksonville State University, Jacksonville, AL 36265.

Years of inattention to proper nutrition and adequate exercise may decrease the quality of life of the elderly. The purpose of the study was to assess the perceptions of senior citizens dietary habits at home and forms of physical activity. A descriptive research design was utilized. The subjects included persons aged 65 to 86 years. Of the forty eight senior citizen participants, sixty eight percent ate three meals a day. However, it was found that attention to the four basic food groups was minimal. It was discovered that eighty one percent of this sample eats alone. Fiber was included in daily meal consumption by eighty seven percent. Attention was given to calcium intake. Eighty three percent reported taking in some form of calcium each day. Fruits consumed in a day ranged from one to three. Exercise activities including walking and dancing were reported by sixty four percent of the seniors. Thirty five percent of the elderly in this study reported no form of physical activity that could be considered exercise. There are many implications from this study. Health education targeted for the elderly is needed. The benefits to be gained from eating right and exercising should be emphasized to the elderly.

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SEVERE BULIMIA SIMULATING AN ENDOCRINOPATHY. Momoko Nishikori, Kyoto Medical Education Program, Kyoto, Japan. Robert E. Pieroni and Patrick Bosarge, University of Alabama School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487.

A 30-year old Japanese female was hospitalized several times because of generalized malaise, considerable weight loss and secondary amenorrhea. The weight loss began two years previously at about the time of her mother's death, and her menses had become irregular and finally stopped several months prior to her admission. The patient had recently encountered severe marital problems. Multiple other complaints were described including dizziness on arising, polyuria and nocturia x10. The patient vigorously denied manifestations of bulimia or anorexia nervosa; abuse of laxatives, diuretics, or other drugs, nor increased diarrhea or vomiting. Her countenance was one of "la belle indifference." Her K⁺ on admission was just 2.2mEq/L with severe metabolic alkalosis. Her blood pressure was low with orthostasis. Muscle enzymes and amylase were elevated. Multiple studies were performed to rule out endocrine dysfunction such as Cushing's disease, Bartter or pseudo-Bartter syndrome, Liddle disease, primary and secondary hyperaldosteronism among other possible causes of hypokalemia. The possibility of cancer was worked up extensively with negative results. Constant observation was made of the patient's activities and it was found that the patient was spending inordinate time in the toilet, and, finally, self-induced vomiting was observed. After ruling out other disorders, and correcting metabolic and nutritional imbalances, psychiatric assistance was obtained. The patient improved considerably. Several aspects of this interesting case will be discussed in detail with special emphasis on potential causes of hypokalemia as well as increased CPK and amylase.

SEPTO-OPTIC DYSPLASIA - A RARE YET POTENTIALLY LIFE-THREATENING CAUSE OF DIABETES INSIPIDUS IN THE NEONATE. Guy W. Sneed, Dept. of Family and Community Medicine, University of Alabama at Birmingham, Birmingham, AL 35294.

Septo-optic dysplasia is a disorder of embryonic development. It is a rare malformation of anterior midline structures of the brain usually including (1) agenesis of the septum pellucidum; (2) a primitive optic (3rd) ventricle; and (3) hypoplasia of the optic nerves, chiasm, and infundibulum. A 2 month old female with seizures, pendular nystagmus with roving eye movements, hypoglycemia and hypernatremia was diagnosed with septo-optic dysplasia via MRI scan. Resultant hypothalamic-pituitary insufficiency including decreased growth hormone and life-threatening diabetes insipidus was seen. Both of these conditions were corrected with hormone replacement therapy (i.e. growth hormone and anti-diuretic hormone). The patient's diabetes insipidus, while highly labile, was sensitive to anti-diuretic hormone and required painstaking titration to achieve stable serum sodium levels. The rareness of this case associated with such classical clinical findings makes it particularly noteworthy to study.

Abstracts

CYTOKINES AND CHRONIC FATIGUE IMMUNE DYSFUNCTION SYNDROME (CFIDS): A REVIEW. Mark T. Richardson, Robert E. Pieroni, Paul A. LeBlanc, Lisa Lloyd, University of Alabama, Tuscaloosa, AL 35487. Petra Shuler, Mississippi State University, Starkville, Mississippi.

CFIDS remains an idiopathic, debilitating illness characterized by profound fatigue, neurological problems, and additional variable symptomology. It has been hypothesized that cytokines may be involved in the causal pathway leading to CFIDS symptomology. Cytokines participate in virtually all responses of the immune system, and may also influence neuroendocrine function. The purpose of this review is to examine the relationship between cytokines and CFIDS. Elevated circulating levels of several cytokines (interleukins (IL) -1, -2, and -6, neopterin, interferon (IFN) -alpha, tumor necrosis factors (TNF) -alpha and -beta, and serum transforming growth factor beta (TGF-beta)) have been reported in some CFIDS patients compared to healthy controls, but study results are inconsistent. Conversely, IL-10 has been reported to be absent in one group of CFIDS patients. Elevated cerebral spinal fluid levels of IFN-alpha have been reported in a group of CFIDS patients. Data from peripheral blood mononuclear cell cultures of CFIDS patients have revealed increased IL-6, IL-1 beta, and TNF-alpha, as well as decreased TGF-beta, IL-2, and IFN-gamma cytokine production. Finally, limited data, including a study we recently performed, have not revealed post-exertional increases in circulating levels of several cytokines in CFIDS patients. In conclusion, one or more cytokines have not emerged from the available data as being consistently related to CFIDS. However, given the continuing advances in the area of cytokine/cytokine receptor research, more extensive studies are warranted to extend this new information into the CFIDS field.

ADVANCES IN DIAGNOSIS AND THERAPY OF DEEP VEIN THROMBOSIS AND PULMONARY EMBOLI. Robert E. Pieroni and Tracy Johns. University of Alabama School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487.

Pulmonary thrombo-embolism (PTE) causes over 100,000 deaths yearly in the United States, and contributes to 100,000 additional deaths. It has been estimated that deep vein thrombosis (DVT) and PTE result in over one-half million hospitalizations yearly. PTE can develop insidiously without clinical evidence of DVT and can be lethal within 30 minutes of symptom onset. Medical personnel should maintain a high degree of vigilance in patients, especially those at high risk, who display even mild manifestations of DVT/PTE. It has been stated that fatal PTE may be the most common preventable cause of hospital deaths. We shall evaluate characteristics of DVT and PTE, including risk factors, clinical manifestations, methods of diagnosis, as well as prophylactic and therapeutic modalities. Special mention will be made of the role of new low molecular weight (LMW) heparin preparations.

Abstracts

Juvenile Chronic Myelogenous Leukemia (JCML): Bench to Bedside. Peter D. Emanuel, Dept. of Medicine, University of Alabama at Birmingham, Birmingham, AL 35294, and Robert P. Castleberry, Dept. of Pediatrics, Children's Hospital of Alabama, Birmingham, AL 35294.

JCML is a rare myeloproliferative disorder of early childhood, which is distinct from adult type, Philadelphia chromosome positive CML. Morbidity/mortality are often due to monocytic cell infiltration into tissues leading to hemorrhage and/or organ dysfunction. Transformation to an acute leukemia occurs infrequently. Response to conventional chemotherapy is quite poor. Bone marrow transplantation offers some hope for cure, but is hindered by a 50% relapse rate and a 20% long term survivor rate. Based on laboratory investigations, a pilot clinical trial was initiated to treat JCML patients with 13-cis retinoic acid. Of the 10 patients enrolled, there were 2 complete responses, 3 partial responses, 1 minimal response, and 4 with disease progression. To date the partial and complete responders have had responses lasting 36-83 months. Follow-up laboratory investigations have indicated a potential mechanism of action for the retinoic acid. In vitro, JCML marrow and peripheral blood cells show abundant spontaneous proliferation of granulocytic/monocytic colonies at low cell densities without exogenous growth factors. After ruling out autocrine and paracrine-driven mechanisms, we demonstrated that the JCML progenitor cells are selectively hypersensitive (10-fold) to granulocyte-macrophage colony-stimulating factor (GM-CSF). This was the first demonstration of a myeloid leukemia in which hypersensitivity to a specific growth factor appeared to be involved in disease pathogenesis. Further, following a clinical response to retinoic acid, JCML samples show a shift of the GM-CSF hypersensitivity back towards normal, suggesting that the retinoic acid is modulating the GM-CSF cellular response.

ILLICIT DRUG USE IN PREGNANCY: WHO IS USING? Judith Cooper, RN, MSN and Donna Shaw, RN, MSN, Dept. of Nursing, Troy State University, Troy, AL 36082

The purpose of this study was to determine the prevalence of illicit drug use among pregnant women in a segment of the private sector in Alabama. Specifically, a nonexperimental design was used in a blind study to identify drug metabolites in the urine of pregnant women at the first antepartal visit. Abbott's TDx was used to screen 271 urine samples for marijuana, cocaine, opiates, and barbiturates. All positive results were confirmed with an alternate method, gas chromatography/mass spectrometry. That method claims 95% to 100% confidence. Analysis revealed that 15 (5.5%) of the subjects used at least one drug. Marijuana and cocaine were most frequently the drugs of choice. African-American women used cocaine more than caucasian women while caucasian women used more marijuana. Women in rural areas used more illicit drugs than those in urban areas. Findings suggest the need for further research to target high risk populations and to appropriate funding for educational and social support programs. The support of Troy State University, The Alabama State Health Laboratory, Dr. Mary C. Henderson and Dr. Charlene Schwab is gratefully acknowledged.

Abstracts

IDENTIFICATION OF THE CHICKEN T-CELL RECEPTOR γ GENES. Adrien Six, Jonathan P. Rast, Yue Li, Max D. Cooper, Chen-lo H. Chen and Gary W. Litman. University of Alabama at Birmingham, and the Howard Hughes Medical Institute, Birmingham, Alabama; University of South Florida, All Children's Hospital, St. Petersburg, Florida.

An adult chicken spleen cDNA library was screened with two PCR products obtained from genomic DNA using short primers with low degeneracy to highly conserved regions of T-cell receptor (TCR) and immunoglobulin genes. Full-length clones were obtained that display characteristics similar to those of TCR γ chains in mammals, including canonical residues thought to be important for proper folding and stability. Northern blot analyses using a cDNA probe revealed a 1.9 kb transcript in thymus, spleen and $\gamma\delta$ T cell lines. Three V γ families, three J γ gene segments and a unique constant region C γ have so far been identified. Southern blot analyses indicate that each V γ family consists of 6-8 members, whereas only one C γ gene was detected with the C γ probe. Subclones of germline V γ 1 and V γ 2 family members contain typical recombination signal sequences. Unlike their mammalian counterparts, the avian leader sequence and V γ region are encoded by a single exon, as is the case for the chicken TCR V α genes. Interestingly, C γ transcripts were detected in 3 of 5 chicken $\alpha\beta$ cell lines, the presence of which is correlated to the expression of a TCR γ protein identified by the G13 monoclonal antibody. Characterization of the TCR γ genes in the chicken provides new insight into the evolution of TCR genes and will allow analysis of the functional interactions between the $\alpha\beta$ and $\gamma\delta$ subsets of T cells in the avian model. (NIH grants AI30879, CA13148, AI23338)

STUDY OF STUDENTS' SKILLS AND PERCEPTIONS REGARDING HOSPITAL AND LONG TERM CARE FACILITY CLINICAL EXPERIENCES. Jane H. Freeman, College of Nursing, Jacksonville State University, Jacksonville, AL 36265.

In 1990, the Southern Regional Education Board (SREB) published a position paper, "Caring for an Aging Society: Issues and Strategies for Gerontology Education." Its first recommendation was that the curriculum of every educational program that prepares health and human services professionals to serve adults should include coursework and clinical experience in dealing with problems of aging. They felt that it is especially critical that gerontology be included in all entry-level curricula. The purpose of this study was to compare the skills and perceptions that nursing students develop during their clinical experiences in long term care facilities with those that they developed during their hospital experiences. The students were surveyed at the end of their first clinical course. The total number of students surveyed was 141 over three consecutive semesters. A questionnaire was utilized to collect the data.

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EPITOPES LOCATED BETWEEN AMINO ACIDS 192-299 IN THE α -HELIX OF PNEUMOCOCCAL SURFACE PROTEIN A (PSPA) ARE BOTH PROTECTIVE AND CROSS-REACTIVE. Beth A. Ralph, David E. Briles, and Larry S. McDaniel, Univ. of Alabama at Birmingham, Birmingham, AL 35294-2170.

Streptococcus pneumoniae is a major cause of disease not only in the United States but world-wide. PspA is a serologically variable protein present on the surface of all pneumococci. It is necessary for full virulence of the organism and is able to elicit detectable protective antibodies. Immunization with a single full-length PspA has been shown to elicit protection against fatal infection with 14 out of 14 different pneumococcal isolates representing 5 capsular types. The immunization prevented death with 8 isolates, delayed death 4 to 12 days with 4 strains, and delayed death 1 to 2 days with 2 strains.

Previous research has shown that the protection-eliciting epitopes of PspA are not restricted to the N-terminal end of the molecule. We have shown that the epitopes recognized by 4 out of 5 monoclonal antibodies which bind to and protect against *S. pneumoniae* WU2 mapped to a region of *S. pneumoniae* Rx1 PspA between amino acids 192-260. Using the polymerase chain reaction, we have cloned two fragments of Rx1 *pspA* that encode amino acids 192-588 (pBC100) and 192-299 (pBC416) of Rx1 PspA. Immunization of mice with the truncated PspA encoded by pBC100 was able to protect against the same panel of challenge pneumococci that full-length PspA was able to protect against. Immunization with the truncated PspA produced by the pBAR416 construct was able to elicit an antibody response that was able to extend life or completely protect mice against challenge with 12 out of the 14 different isolates. Primers based on Rx1 *pspA* were able to amplify the 193 to 260 homologous coding region from 9 of 11 other strains of *S. pneumoniae*.

AMYLOIDOSIS: THE FORGOTTEN DISEASE. Robert E. Pieroni and Gaye Harbin. University of Alabama School of Medicine, Tuscaloosa, Tuscaloosa Program, Tuscaloosa, AL 35487.

The term amyloid ("starch like") was coined by Virchow in 1894. Amyloidosis consists of several disorders of unknown etiology characterized by extra-cellular deposition of an eosinophilic protein in one or more tissues. We shall present the case of an elderly male who for years had suffered, at various times, severe multi-organ disorders (e.g., pumonary, renal, GI, dermatologic, hematologic, and rheumatologic) and had been evaluated in numerous medical centers by scores of physicians without a definitive diagnosis. He continued to deteriorate physically and displayed multiple abnormal laboratory tests. After initially recommending a kidney biopsy, a rectal biopsy was performed for fear of renal bleeding. Congo red staining was positive and the patient is being treated for primary amyloidosis with prednisone, melphalan, and other modalities. This case well illustrates the application of Occham's razor ("the law of parsimony") in which an attempt is made to incorporate multiple features into one underlying disease entity. The classification and characteristics of the various forms of amyloidosis will be presented.

Abstracts

CHROMATOGRAPHIC SEPARATION OF FOUR STEROIDS FROM THE SAME SERUM SAMPLE IN STUDIES OF HYPERANDROGENIC PATIENTS. Larry R. Boots, H. Downing Potter and Ricardo Azziz. Dept. of OB/GYN, Univ. of AL at Birmingham, Birmingham, AL 35294.

Hyperandrogenemia in female patients is most often studied with a battery of steroid tests for serum total testosterone, free testosterone and sex hormone binding globulin. Other steroids may also be of interest but commercially available kits often require large amounts of serum and are seldom precise, accurate or specific enough to provide consistently useful data. We present here a procedure which can separate four steroids, progesterone (P_4), 17 alpha-hydroxyprogesterone (17-OH- P_4), pregnenolone (P_5) and 17 alpha-hydroxypregnenolone (17-OH- P_5) from a single aliquot of serum. By separating the four steroids from a single aliquot of serum, serum can be conserved and the lack of specificity in each assay procedure overcome. In this study, each steroid in tritiated form (greater than 10,000 CPM) was taken to dryness and reconstituted in 0.1 ml methylene chloride: methanol (95:5) and applied to a Sephadex LH 20 column (21 cm long x 1.0 cm I.D.). Aliquots of 1 or 2 ml were collected and counted to establish the chromatographic profile. The steroids eluted from the column in the following order: P_4 , 3rd ml; 17-OH- P_4 , 4th ml; P_5 , 5th ml; 17-OH- P_5 , 6.5-7.5 ml. When all four tritiated steroids were added to serum, extracted (0.2 ml serum plus 0.8 ml deionized water extracted by gently mixing for 10 minutes with 5 ml diethyl ether), taken to dryness, reconstituted in 0.2 ml of column solvent and chromatographed, distinct peaks with recoveries ranging from 66% to 95% were obtained. Each aliquot can then be quantitated in the appropriate assay.

ATTITUDES OF RNS TOWARD THE USE OF COMPUTERS. Mollie K. Bradley, College of Nursing, Univ. of S. Ala., Mobile, AL 36604.

The purpose of this study was to determine the attitudes of practicing registered nurses in the application of computer technology in providing nursing care in the hospital setting. A stratified random sample of 350 nurses was selected from the membership of the American Nurses' Association. Data were analyzed through the use of the Statistical Analysis System (SAS). Differences were found among the five groups of nurses at the 0.05 level of significance. Of the five groups of nurses, nursing administrators reported the most positive attitudes toward computer technology and maternal-infant nurses reported the most negative attitudes toward computer technology. Personal computer use, length of nursing experience, and number of seminars, conferences, and workshops related to computer technology attended by the participants were positively correlated with nurses' attitudes toward computer technology. Findings from this study revealed that computer technology utilized in hospital settings was not meeting the needs of staff nurses. One major implication was that all individuals involved in the care of patients, from administrators to staff nurses, should focus on continuous improvement of computer systems in health care delivery to facilitate delivery of quality care to patients.

Abstracts

STUDIES OF MATERNAL SERUM FREE B-HCG LEVELS DURING THE SECOND TRIMESTER OF PREGNANCY. Larry R. Boots and Sue C. Bishop, Dept. of OB/GYN, Univ. of AL at Birmingham, Birmingham, AL 35294.

The clinical utility of maternal serum levels of alphafetoprotein (AFP), intact human chorionic gonadotropin (hCG) and unconjugated estriol (UE₃) in predicting the occurrence of Down syndrome-affected pregnancies has been well established. More recently, replacement of hCG measurements with free B-hCG levels has been advocated. Since free B-hCG levels are very low and commercial assays relatively unavailable, studies of free B-hCG and Down syndrome have been difficult. The purpose of this study was to measure free B-hCG levels using a commercially available kit (CIS Biointernational, France), defining normal ranges and relationships to race, age, other physiologic factors and relative to levels of AFP, intact hCG and UE₃. A total of 460 patient sera (251 white, 209 black) were studied. Free B-hCG levels declined from 29 ng/ml for blacks and 32 ng/ml for whites at 14 weeks of gestation to 8 and 9 ng/ml, respectively, at 21 weeks. Intact hCG levels were higher for blacks at 14 weeks (58,274 mIU/ml) than for whites (51,525 mIU/ml) but converged by 21 weeks (16,297 vs 16,956 mIU/ml, respectively). The difference between races for free B-hCG was not statistically significant but the correlation between free B-hCG and intact hCG was ($P < 0.0001$). Maternal age had no effect on free B-hCG levels but a stepwise regression analysis revealed that complex interactions affect normal levels of free B-hCG and that multiple adjustments are required before interpreting comparisons between normal levels of free B-hCG and those levels observed in association with complications of pregnancy.

Retrospective study of insulin-like growth factor-I and its binding proteins in second trimester pregnancy. Da-Chang Chu, Medical Genetics and Larry R. Boots, Dept. of OB/GYN, University of Ala. at Birmingham.

Insulin-like growth factors (IGFs) and their specific binding proteins (IGFBPs) are believed to participate in growth control. Retrospective study of maternal serum and amniotic fluid was performed for the purpose of establishing reference concentration ranges for IGF-I, IGFBP-1, and IGFBP-3 in maternal serum and amniotic fluid from 14 to 20 weeks of pregnancy. Appropriate corrections for sample age, race, fetal sex, gestational age, maternal age, and maternal weight were made and reference values were determined as follows: amniotic fluid IGFBP-1 - 15434.8, 18858.2, 23361.5, 29342.7, 37368.0, 48250.3, 63168.4 (ng/ml); amniotic fluid IGFBP-3- 3548.1, 3767.0, 3999.5, 4246.2, 4508.2, 4786.3, 5081.6 (ng/ml), for 14 to 20 gestational week, respectively. Maternal serum IGF-I concentrations did not vary significantly with gestational weeks during the second trimester. Preliminary studies of these factors in amniotic fluid from pregnancies complicated by Down syndrome, intrauterine growth retardation, and twin pregnancies showed that 56%, 50%, and 64% had decreased IGFBP-1 while 85%, 95%, and 82% had decreased IGFBP-3, respectively. Maternal serum IGFBP-3 data were more complicated because many factors, including maternal age and gestational age, were involved and require further study.

Abstracts

THE DETERMINATION OF CONFORMATION AND MECHANISM OF GRAMICIDIN A TRANSMEMBRANE CHANNEL BY NMR. Najie Jing and Dan W. Urry. Laboratory of Molecular Biophysics, The University of Alabama at Birmingham, P.O. Box 300, UAB Station, Birmingham, AL 35294-0019

In this report, first, Malonyl gramicidin, $\text{CH}_2(\text{CO}-\text{L}\cdot\text{Val}^1-\text{Gly}^2-\text{L}\cdot\text{Ala}^3-\text{D}\cdot\text{Leu}^4-\text{L}\cdot\text{Ala}^5-\text{D}\cdot\text{Val}^6-\text{L}\cdot\text{Val}^7-\text{D}\cdot\text{Val}^8-\text{L}\cdot\text{Trp}^9-\text{D}\cdot\text{Leu}^{10}-\text{L}\cdot\text{Trp}^{11}-\text{D}\cdot\text{Leu}^{12}-\text{L}\cdot\text{Trp}^{13}-\text{D}\cdot\text{Leu}^{14}-\text{L}\cdot\text{Trp}^{15}-\text{NHCH}_2\text{CH}_2\text{OH})_2$, was used to form the peptide channel, and dodecyl phosphocholine (DPC), $\text{CH}_3(\text{CH}_2)_{11}\text{PO}_4(\text{CH}_2)_2\text{N}(\text{CH}_3)_3$, was used to package malonyl gramicidin molecules into micelles as a model lipid environment. The quality of the incorporation was assessed by CD spectra and relaxation studies of ^{31}P -NMR; the relaxation times, T_1 and T_2 , were distinctly decreased when gramicidin molecules were incorporated into DPC micelles. Two-dimensional proton NMR was employed to determine the conformation of the ion interacting state. The COSY and NOESY spectra of malonyl gramicidin incorporated into perdeuterated DPC (d_3g) micelles in D_2O and in H_2O (90%) were obtained at 70°C , pH4.4. Assignments of the resonances and the peptide sequence were determined based on the proton spin systems and the NOE spatial connectivities (d_1 and d_3). Analyses of nuclear Overhauser effects and spin-spin couplings in the NOESY maps show that 17 interturn NOE connectivities fit the structure an amino end-to-end dimerized, single-stranded, right-handed b-helix with approximately 6.3 residues per turn.

Next, based on this structure, the determination of cation binding sites for Gramicidin A (GA) in DPC micelles becomes a significant step in the study of ion transport through the model channel. First, the investigation of cation binding sites in DPC micellar-packaged Gramicidin A was achieved by ^{13}C -NMR experiments at 30°C using four C-13 labeled GA samples. Then, the analyses based on two different equations, one for single and one for double occupancy, were employed to evaluate the correct occupancy model for GA in DPC micelles. The results clearly indicate double occupancy to be correct for Na^+ ion as well as for K^+ , Rb^+ , Cs^+ and Tl^+ ions. Finally, the binding constants for Na^+ ion were also estimated by the measurement of the longitudinal relaxation time (T_1) using ^{23}Na -NMR of the same sample at the same temperature as used for the ^{13}C NMR study. The binding constants obtained from ^{23}Na NMR are essentially equivalent to those determined from the ^{13}C chemical shifts.

IMPORTANT CONSIDERATIONS IN IMMUNOTHERAPY OF ALLERGIC PATIENTS.

Robert E. Pieroni and Lorin Baumhover, University of Alabama School of Medicine, Tuscaloosa, AL 35487.

One of us, (L.B.), has had several anaphylactic attacks from yellow jacket stings, and had milder symptoms during immunotherapy (IT) that has had to be quite prolonged (greater than 12 years) due to his unusual hypersensitivity. During his first and most severe attack, he was discharged from the Emergency Department with minimal treatment, and no advice about possible advantages of IT. Later, when he was skin-tested, he was found to be sensitive to three species of Hymenoptera for which he is receiving IT. There is no evidence of fire ant sensitivity. Our presentation will review characteristics of insect hypersensitivity, discuss the safety of properly performed skin testing, and some of the features of patients who sustained severe reactions, including deaths, during IT. The need for early recognition and treatment of symptoms of anaphylaxis, and careful observation of patients after IT injections will be emphasized. Additionally, we shall discuss the inadequate knowledge of many Emergency Departments and other physicians about the value of IT in selected patients, and possible methods to augment their knowledge of his potentially life-saving modality. Problems related to in vitro blood testing and practice of "allergy at a distance" will also be discussed.

Abstracts

PERCEIVED STRESS AND HARDINESS IN FEMALE DEANS OF SCHOOLS OF NURSING. Sheila Virgin, College of Nursing, E.T.S.U., Johnson City, Tn.

The personality characteristic hardiness and perceived stress in female deans of schools of nursing (SON) were studied using a conceptual framework incorporated the variables, perceived stress and hardiness. Descriptive and inferential statistics were used, including t tests, chi square, and correlations. The population included 574 deans from NLN-accredited SONs offering a baccalaureate degree or higher in the United States, Virgin Islands, or Puerto Rico. A Dean's Demographic Survey, the Administrative Stress Index, and the Personal Values Survey were used. A total of 336 female deans were the sample for this study. Strong relationships between perceived stress levels and job satisfaction with the hardiness subcomponents, commitment, control, and challenge were identified. Significant relationships were identified with the hardiness scale and its subcomponents with perceived coping levels and the number of nursing faculty. The number of years in the deanship position significantly correlated with perceived stress levels and with perceived coping levels. The age of the dean, the number of years as a dean, and educational level showed no correlation to hardiness or the subcomponents of hardiness. Age showed a significant relationship with perceived stress and coping levels.

CEREBRAL ACHROMATOPSIA: CENTRAL COLOR VISION LOSS SECONDARY TO STROKE. Patti Fuhr, Thomas Kuyk, School of Optometry, UAB. Daniel L. Drane, The Department of Veterans Affairs Medical Center, Birmingham, AL

A 52 year old male with a history of bilateral carotid stenosis and multiple strokes presented to our low vision clinic with right-sided and superior visual field loss with macular sparing (best corrected visual acuity right eye 20/20, left eye 20/40, due to amblyopia). A major complaint of this patient was "seeing the world in black, white, and shades of gray." Prior to the strokes he had normal color vision. Total loss of color vision secondary to cortical damage is a rare condition, referred to as cerebral achromatopsia. It is caused by bilateral damage to the occipitotemporal cortex (area V4 in monkey). Other perceptual deficits that may occur due to the proximity of association areas are visual disorientation, geographic disorientation, visual neglect, dressing or constructional apraxia, prosopagnosia, and hemianopias, dependent upon the extent of the infarct. Along with profound deficits in color vision, this patient demonstrated decreased motion sensitivity. Routine contrast sensitivity was in the range of normal, but under conditions that stress the visual system the patient showed severe losses. Neuropsychological examination ruled-out the possibilities of color anomia or color agnosia. Visual and verbal short-term memory, verbal learning, and facial recognition were also significantly impaired. Visuo-spatial integration remained intact, and there was no evidence of visual neglect. Prosopagnosia was suspected. This unusual case dramatically demonstrates the distinct and separate losses that can occur with damage to specific cortical areas in the parallel pathways of the visual system.

Abstracts

THROMBOCYTOPENIA IN AIDS PATIENTS: EVALUATION AND TREATMENT. Robert E. Pieroni and Tracy L. Johns. University of Alabama School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487.

Thrombocytopenia (defined as a decrease in platelet count to less than $150,000/\text{mm}^3$) is a potentially life-threatening condition which can result from numerous causes. It is often observed in AIDS patients, and identifying an exact etiology may be difficult. A 36 year old African American male with AIDS diagnosed one year ago presented to the emergency department complaining of worsening non-productive cough, chills and abdominal pain. His past medical history includes tuberculosis treated for one year; however, non-compliance with therapy has been reported. Medications on admission included nystatin suspension, isoniazid and trimethoprim-sulfamethoxazole. He reported a history of treatment with zidovudine. The patient was treated with multiple antimicrobial regimens throughout his stay. On hospital day 19, he became acutely short of breath. A ventilation-perfusion scan reported high-probability for pulmonary thromboembolism and intravenous heparin therapy was initiated. Notably, on day 25 of hospitalization, two plus acid-fast bacilli were identified from a sputum sample and treatment with a drug regimen including rifampin was initiated. After seven days of heparin therapy (two days of rifampin therapy), the patient became thrombocytopenic and began experiencing hemoptysis. Heparin and rifampin were discontinued, with gradual recovery of the patient's platelet count. A specific test for heparin-induced platelet aggregation was negative. This case illustrates contributors to thrombocytopenia in patients with AIDS; in addition to the disease itself, pharmacotherapy should be recognized as a potential cause of this condition.

SEPTO-OPTIC DYSPLASIA - A RARE YET POTENTIALLY LIFE-THREATENING CAUSE OF DIABETES INSIPIDUS IN THE NEONATE. Guy W. Sneed, Dept. of Family and Community Medicine, Univ. of AL at Birmingham, Birmingham, AL 35294.

Septo-optic dysplasia is a disorder of embryonic development. It is a rare malformation of anterior midline structures of the brain usually including; (1) agenesis of the septum pellucidum; (2) a primitive optic (3rd) ventricle; and (3) hypoplasia of the optic nerves, chiasm, and infundibulum. A 2 month old female with seizures, pendular nystagmus with roving eye movements, hypoglycemia and hypernatremia was diagnosed with septo-optic dysplasia via MRI scan. Resultant hypothalamic-pituitary insufficiency including decreased growth hormone and life-threatening diabetes insipidus was seen. Both of these conditions were corrected with hormone replacement therapy (i.e. growth hormone and anti-diuretic hormone). The patient's diabetes insipidus, while highly labile, was sensitive to anti-diuretic hormone and required painstaking titration to achieve stable serum sodium levels. The rareness of this case associated with such classical clinical findings makes it particularly noteworthy to study.

Abstracts

SYNTHESIS OF POTENTIAL ANTI-TRYPANOSOMAL AGENTS. Charles L. Newton and Julio F. Turrens, Department of Biomedical Sciences, University of South Alabama, Mobile, AL 36688-0002

The metabolic differences between parasites and hosts may be targets for drug development, particularly for intracellular parasites which are protected from the hosts immune response (i.e., *Trypanosoma cruzi*). The enzyme NADH-fumarate reductase (FR) is present in *Trypanosoma brucei* procyclic trypomastigotes and all forms of *T. cruzi*, but not in mammalian cells. We identified two FR inhibitors (L-341,828 and L-092,201 originally designed by Merck, Sharp and Dohme labs. against other parasites) that inhibit the enzyme from *T. brucei* but are no longer available. An attempt was made to synthesize both compounds. The products were analyzed using nuclear magnetic resonance (NMR), mass spectrometry (fast atom bombardment, FAB), and measuring melting points. L-341,828 was successfully synthesized as indicated by the presence of a FAB peak corresponding to its molecular weight, a melting point of 300-305 °C and through NMR. An attempt to synthesize L-092,201 was unsuccessful. However, one of the reagents (mercaptopyridine N-oxide, MPNO) turned out to be also a potent FR inhibitor. The ID₅₀ for L-341,828 and MPNO were 5 and 3 µg/ml, respectively. These drugs were tested on several mammalian NADH- and succinate-dependent activities, including NADH-cytochrome *c* reductase, succinate-cytochrome *c* reductase and lactic dehydrogenase. The effect of both drugs on these mammalian enzymatic activities was minimal. This suggests that these drugs may be selectively toxic against the forms of FR found in trypanosomatids. All drugs were also tested on *T. brucei* procyclic trypomastigotes in culture. These drugs inhibited cell growth in culture at concentrations that inhibited FR activity. Since both MPNO and its derivative L-092,201 as well as NADH (the enzyme substrate) contain a pyridine ring, we propose that these drugs may interfere with substrate binding. (Supported by PHS #1R15 AI 32703-01 TMP).

STRONGYLOIDES AND INVASIVE BACTEREMIA RECENTLY DETECTED IN WORLD WAR II VETERANS. Tomoko Takayanagi, Kyoto Medical Education Program, Kyoto, Japan. Robert E. Pieroni and Jerry Jones, University of Alabama, School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487.

Strongyloides stercoralis was first discovered in 1896 in French soldiers returning from Southeast Asia. This round worm (nematode) is found mainly in the tropics and is endemic in the southeastern United States. Eggs hatch in the human intestines and release larvae which may reinvade the host or infect others via skin penetration. The major but rare pathological feature is a "hyperinfection syndrome" in which gut involvement allows passage of enteric bacteria, often resistant to antibiotic therapy, with corresponding high mortality rates. Waning immunity from a variety of causes may enhance this syndrome which can have a markedly prolonged lag time. We recently successfully treated a severely ill Japanese male for strongyloidiasis and polymicrobial infection. During WWII, he had been stationed in Palao, a highly endemic area. No underlying cancer, or other contributory disorders were found for this reactivation. However, age itself is associated with lessened immunological responsiveness, and might account for his susceptibility to the hyperinfection syndrome. Continued vigilance should be exercised to detect the recurrence of hyperinfection syndrome in susceptible subjects, including veterans who had been stationed in Southeast Asia, as well as immigrants from that area.

A Novel Triplex Forming Oligonucleotide Can Inhibit *c-myc* Transcription *in vitro*. Hyung-Gyoon Kim¹ and Donald Miller^{1,2}

1.Department of Biochemistry and Molecular Genetics and 2.Department of Medicine, University of Alabama at Birmingham, Birmingham, Alabama, 35294-0001.

Triplex forming oligonucleotides (TFOs) have been known to bind to DNA targets in a sequence specific manner in several human gene promoters such as the epidermal growth factor receptor, IL-2 receptor, and the dihydrofolate reductase genes. TFOs have been also shown to inhibit transcription *in vitro* and the expression of target genes in cell culture. The human *c-myc* protooncogene, which is overexpressed in many malignancies, contains a 23 base pair purine-pyrimidine rich motif with one interruption in its p2 promoter, which can be a potential target for purine:purine:pyrimidine triplex formation. Electrophoretic mobility shift analysis (EMSA) and competition experiments show that this purine-pyrimidine motif is a binding site for the HeLa nuclear proteins. We have shown the formation of an intermolecular triplex using a 23 base purine rich oligonucleotide antiparallel to the purine rich target sequence. Triplex formation by this oligonucleotide prevents the binding of protein to the target site. DNase I footprinting was performed to confirm the exact location of triplex formation. It was also shown that this TFO is a potent and specific inhibitor of *c-myc* transcription in an *in vitro* assay. These data suggest that this novel TFO inhibits transcription of the *c-myc* protooncogene by blocking the binding of important regulatory factors and may show the possibility of using TFOs for the specific inhibition of *c-myc* *in vivo*.

CONTRAST RESPONSE FUNCTION OF THE PERIPHERY EFFECT. Patti Fuhr and Thomas Kuyk, Department of Physiological Optics, School of Optometry, UAB and The Department of Veterans Affairs Medical Center, Birmingham, Alabama.

The periphery effect (PE) is a change in the activity of a neuron that is elicited when a remote stimulus located well outside the neuron's receptive field is moved, shifted, or flickered. The effect is stronger in monkey magnocellular (M-) neurons and cat Y-cells than it is in parvocellular (P-) neurons or X-cells. Furthermore, the PE in Y-cells saturates at low levels of contrast of the remote stimulus. Human correlates of the PE point to involvement of M-neurons. The purpose of this study was to determine if the PE in humans saturates at low levels of contrast of a remote stimulus as it does in cat Y-cells. **Methods:** Five color normal adults set thresholds for detection of flicker and color in 1.2° rapidly flickering (25 Hz) green or red spots presented foveally. Detection of fast flicker and color are believed to be mediated by M- and P-neurons, respectively. Test stimuli were on continuously and superimposed on a 4°, 100 cd/m² white background. Remote stimulation was provided by a large white surround of the same luminance that was flickered at 15 Hz. Contrast of the surround was varied between 0% (no remote stimulation) and 50% in 8 stages. **Results:** At maximum surround contrast, mean flicker detection thresholds for the green and red targets were elevated by 0.44 and 0.34 log units, respectively, but no threshold changes were found for color detection. The effects of increasing surround contrast on flicker thresholds were not linear. For the green and red stimuli, half-saturation values for flicker were .29 & .16, those for color were 2.21 and 1.95, respectively. **Conclusions:** The response of the human PE to changing contrast shows evidence of saturation at low levels of contrast of a remote stimulus. T32-07033, EY-03039, and VA C695-RA.

Abstracts

EFFECTS OF SHBG LEVELS ON DIFFERENT ASSAYS FOR TESTOSTERONE: IMPLICATIONS FOR ESTIMATING SERUM LEVELS OF FREE TESTOSTERONE. Larry R. Boots, Sally Potter and H. Downing Potter, Dept. of OB/GYN, Univ. of AL at Birmingham, Birmingham, AL 35294.

The measurement of total serum testosterone (T), free T and sex hormone binding globulin (SHBG) have a well-established clinical role in the diagnosis and treatment of female hyperandrogenism and male hypogonadism. Since most patients are studied using commercially available assay kits, we evaluated six different T kits (assays A-F) and compared these data to those obtained with an in-house method. The in-house method involved serum extraction and radioimmunoassay, using a well-characterized T antibody and dextran-coated charcoal for separation of bound and unbound. Levels of T in a female-derived serum pool were 72 ng/dl while for kits A-F, levels ranged from 21 ng/dl to 126 ng/dl. A male-derived pool had T levels of 748 ng/dl by the in-house method and 982 ng/dl to 1708 ng/dl for kits A-F. The intra-assay C.V. was 3.8% for the female pool by the in-house assay and 8.9% to 21.2% for kits A-F. The male pool intra-assay C.V. was 3.1% by the in-house method and 3.3% to 5.5% for commercial kits. Androgen levels were then studied in three groups of men and three groups of women having high, normal or low levels of SHBG. Serum T levels, in men, ranged from 497 to 344 ng/dl using the in-house assay, and 285 ng/dl to 696 ng/dl by kits A-F. In women, T levels ranged from 62 ng/dl to 40 ng/dl in the in-house assay and 6 ng/dl to 173 ng/dl in commercial kits. In conclusion, many commercially available kits for assaying total serum T have unacceptably poor precision and accuracy for use in clinical evaluation of female androgen status.

TRUNCATED *S. PNEUMONIAE* PspA MOLECULES ELICIT PROTECTIVE IMMUNITY AGAINST FATAL PNEUMOCOCCAL CHALLENGE IN MICE. Rebecca Creech Tart, Larry S. McDaniel, and David E. Briles, Bacterial Pathogenesis Laboratory, University of Alabama at Birmingham, Birmingham, AL 35294-2170.

S. pneumoniae strain Rx1 is avirulent, yet PspA from this strain cross-protects mice against a large percentage of pneumococci and truncated Rx1 PspA elicits protection against 70% of strains analyzed to date (unpublished data). Capsular type 4 and 5 strains represent a subset of pneumococci that are more difficult to protect against in the mouse sepsis model. Therefore in this study, truncated *pspA* genes from strains possessing type 4 or 5 capsules were amplified, cloned, expressed, and the recombinant PspA proteins evaluated for their ability to protect mice against subsequent *S. pneumoniae* infection. Truncated PspA proteins were induced in *Escherichia coli* and cell lysates were used to immunize mice. Control animals were sham immunized with lysates from a strain containing the cloning vector alone. Next, mice were challenged with capsule type 4 or 5 parental *S. pneumoniae* strains and with type 3, 6A, and 6B strains. Immunization with the truncated PspAs protected mice against fatal challenge with capsular type 3 strains and extended time to death with type 6A and 6B strains. The three recombinant PspAs failed to offer significant protection against challenge with their respective parental strains. These data demonstrate that truncated PspAs from capsular type 4 and 5 strains elicit protection against types 3, 6A, and 6B *S. pneumoniae* but not types 4 and 5. Future studies will seek to determine if full-length PspA is a more efficient immunogen against pneumococci possessing type 4 or 5 capsules.

Abstracts

RECURRENT THROMBOEMBOLISM IN A PATIENT WITH PROTEIN S AND C DEFICIENCY. Lawrence R. Lacy, Department of Psychiatry, and Robert E. Pieroni, Department of Internal Medicine, University of Alabama School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487.

Primary protein S deficiency is an autosomal-dominant disorder with limited penetrance, variable expression and results in a primary hypercoagulable state that is symptomatic in heterozygous states. Estimated frequencies in the population of symptomatic patients with protein S deficiency range from one in sixteen thousand (0.00625%) to 2.8% of proven deep vein thrombosis with thrombophilia to a full 10% among patients experiencing deep vein thrombosis prior to age 40. Thrombosis can occur in any vascular structure in patients with primary protein S deficiency, but most commonly occurs superficially. The mean age for first event thrombosis is 28 years; however, the range reported is from 15 to 68 years with two thirds of protein S deficient patients experiencing the initial event by age 35. Protein C deficiency is also an autosomal-dominant disorder but is usually asymptomatic in heterozygotes. Primary protein C deficiency (heterozygous) occurs at a frequency in the general population of about 4% but is symptomatic in the frequency of 1:16000. Protein S deficiency associated Legg-Perthes disease in an 8 year old and cerebral infarction in a 13 month old and protein C associated cerebral infarction in a 17 month old have been reported, indicating juvenile thrombophilic states are also relevant. The authors review the literature for protein S and C deficiency states and discuss the case history of a patient with a complicated presentation.

PRIMARY EYE CARE NEEDS IN A DEVELOPING WEST AFRICAN NATION: RESULTS OF A HUMANITARIAN MISSION. Lyman C. Norden, Univ. of Ala. at Birmingham School of Optometry 35294-0010, and Department of Veterans Affairs Medical Center, Birmingham, Alabama, Melvin D. Shipp, Univ. of Ala. at Birmingham School of Optometry, William H. Reid, Arizona Air National Guard

The purpose of this study was to assess the primary eye care needs in a developing African nation. The study population consisted of 603 adults and children examined as part of a humanitarian health mission to Niger, West Africa. Data included chief complaint, habitual acuities, refraction, corrected acuities, medical and visual diagnoses, treatments, and utilization of recycled eyeglasses. The median age range of patients presenting for eye examination was 40-50 (32%), and the most frequent chief complaint was blurred vision (74%). Refractive error distribution peaked markedly in the 0 to +2.50 range. The most common near add determinations were +1.00 (23%), +1.50 (21%), and +2.00 (30%). The most frequent medical ocular diagnoses were external eye disease (18%), cataract (13%), and glaucoma (4%). Thirty (5%) patients were referred for secondary treatment of ocular disease, usually cataract or glaucoma. Of the 117 medications dispensed as primary treatments, the most common were erythromycin ointment (31%) and gentamicin eyedrops (18%). Remarkably, dilated funduscopies revealed no vascular retinopathy in this study population.

Abstracts

UPDATE ON THE PERSIAN GULF "MYSTERY ILLNESS." Robert E. Pieroni, University of Alabama School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487.

During the Persian Gulf War, of the 700,000 American service members who participated, fortunately, a relatively small number were lost in battle, or succumbed to diseases or accidents. However, after the Gulf War victory in 1991, thousands of U.S. service personnel complained of manifestations which have been termed the "mystery illness." Despite many theories, the causes of many of these complaints remain unknown. Signs and symptoms include joint pain, rashes, dyspnea, insomnia, diminished cognition, fatigue, sleep disturbances, alopecia, and bleeding gums, among other complaints. No one denies that some veterans are ill, but numerous attempts to incriminate one causal factor has been unproductive. Indeed, most investigators feel we are not dealing with a single syndrome, and some Department of Defense studies have detected multiple diseases with overlapping manifestations and causes. The many resemblances between the Gulf illness and Chronic Fatigue Syndrome has been the subject of considerable interest and investigation. I shall discuss some leading theories relative to the Gulf illness, my experiences as both a military and a civilian physician treating such patients, and my personal observations and opinions concerning the purported role of biological and chemical agents, vaccinations, depleted uranium, and other agents that have been described by some as being contributory to the "mystery illness."

COPING PROCESSES DURING THE FIRST 48 HOURS AFTER OPEN HEART SURGERY. Anne Russo, RN, MSN, School of Nursing, Univ. of AL at Birmingham, B'ham., AL 35294. Janice Hammond, RN, MSN, Univ. of AL Hospital, B'ham., AL 35233.

The purpose of the study was to identify coping processes, as perceived by the patients, during the first 48 hours after open heart surgery. A qualitative, grounded theory approach was utilized for this study. Seven participants who were hospitalized for undergoing coronary artery bypass grafting were interviewed to describe the first 48 hours after undergoing the procedure and how they coped with it. Ten processes of coping were identified by the researchers, then later validated with the participants. The processes were having (a) a frame of reference/knowning what to expect, (b) a positive attitude, (c) social support, (d) physical and emotional comfort measures, (e) trust in the health care professionals, (f) future plans/goals, (g) spirituality/prayer, (h) open communication with family and staff, (i) validation of expected versus actual post-operative experience, and (j) knowing rationale for procedures. Implications for nursing include assessing the coping processes that are meaningful to the patient, and then facilitating progression in using those processes to cope with open heart surgery.

REGULATED EXPRESSION OF ACTH IN SUBPOPULATIONS OF RAT LEUKOCYTES. P.D. Lyons and J.E. Blalock, University of Alabama at Birmingham, Birmingham, AL 35294.

An animal's response to infectious or inflammatory stressors is a physiologically dynamic process involving alterations of neuronal firing patterns, as well as hormone, and cytokine levels. The hypothalamic-pituitary-adrenal (HPA) axis is an important link in this brain-immune circuitry which is activated by cognate as well as noncognate stressors. Adrenocorticotropin (ACTH) is a peptide hormone of the anterior pituitary that mediates neuroendocrine communication between the hypothalamus and the adrenals. ACTH is also produced by mononuclear leukocytes (MNC), which have *in vitro* functions that can be modulated by ACTH. The present study was undertaken to determine the kinetics and cellular distribution of ACTH immunoreactivity (ACTH-ir) *in vitro* in rat splenic MNC. Cells were cultured with Concanavalin A (ConA), lipopolysaccharide (LPS), or media alone. ACTH-ir intensity peaked at 18-21 hr for all treatments. However, $90 \pm 4\%$ of ConA-treated and $75 \pm 6\%$ of LPS-treated cells were positive, while only $9 \pm 4\%$ of unstimulated cells were positive at 21 hr. A few cells (1-2%) expressed ACTH-ir at 0 hr and these were found to be macrophages (MØ). Double immunofluorescence of T-helper (T_h), T-cytotoxic (T_c) and B cells demonstrated that the total percent of cells with ACTH-ir in these lymphocyte subpopulations did not significantly differ at any single time point or treatment yet, there were significant differences in the intensity levels among the three subpopulations. Activated MØ also increase positivity for ACTH-ir ($85 \pm 5\%$). Western blot analysis of stimulated MNC lysates confirmed that the immunoreactivity was due to an ACTH-like peptide. In conclusion, the nature of the temporal and cellular expression of ACTH in MNC suggest that hormones and neuropeptides, like cytokines, are expressed in an immune response, and offers support to paracrine or autocrine functions of MNC-derived ACTH. Supported in part by NIH grant DK38024

STRATEGIES FOR GENE CONSTRUCTION OF PROTEIN-BASED POLYMERS. T.C. Woods, D. T. McPherson, J. Xu, and D. W. Urry. Laboratory of Molecular Biophysics, The University of Alabama at Birmingham, P.O. Box 300, UAB Station, Birmingham, AL 35294-0019

¹ Using genetic engineering techniques, it is possible to construct a synthetic gene encoding multiple repeats of a peptide sequence. This gene can then serve as a monomer in a self-ligation polymerization reaction to create multimer genes of the starting unit. The "polymer" genes can then be cloned into specialized expression vectors and placed into *E. coli* for the subsequent production of recombinant protein-based polymers. This biosynthetic approach provides a means for producing polymers of fixed-length and racemic purity that is not possible by solid phase chemical synthesis methods. With this approach protein-based polymers of complex composition can be designed and prepared to carry out equally complex free energy transductions of the sort that occur in living organisms.

Abstracts

Identification Of Response Regulators In *Mycobacterium Tuberculosis*. Randall H. Harris, Shelley E. Haydel, William H. Benjamin, Jr., And Nancy E. Dunlap. University of Alabama at Birmingham, Birmingham, AL 35294.

A very common type of regulatory system used by a large variety of bacteria to sense changes in their environments and adapt to them is the two component sensor/response regulator system. These two proteins coordinately regulate the expression or activity of proteins required for various biological activities including nutrient utilization, transformation competence, sporulation, and chemotaxis as well as virulence. In a previous study (Wren et. al., FEMS Micro. Letters, 99, 287-292, 1992), it was demonstrated that response regulators from a variety of pathogenic bacteria including *Mycobacterium tuberculosis* could be amplified by PCR using degenerate oligonucleotide primers derived from PhoP of *Salmonella typhimurium* and PhoB of *Escherichia coli*. Only one response regulator designated *regX3* was identified in *M. tuberculosis*. Using the same approach, fragments of genes encoding two novel response regulators were amplified and cloned from *M. tuberculosis* as well as *regX3*. Sequence analysis of these gene fragments designated *regR* and *regS* verified their identity as a response regulators. Southern blotting and restriction analysis revealed that *regR* was the most common clone representing 30 of the 47 clones screened whereas *regX3* made up about 12%. More extensive screening will probably yield additional response regulators. Further characterization of these regulatory elements and the genes they control in *Mycobacteria* spp. may lead to the identification of new virulence determinants.

A PNEUMOLYSIN-NEGATIVE MUTANT OF *STREPTOCOCCUS PNEUMONIAE* CAUSES CHRONIC BACTEREMIA RATHER THAN ACUTE SEPSIS IN MICE. Kimberly A. Benton, Michael P. Everson, and David E. Briles, Univ. of Alabama at Birmingham, Birmingham, AL 35294-2170.

Pneumolysin is a cytoplasmic virulence factor of *Streptococcus pneumoniae* that can interfere with phagocyte function in vitro. We have examined the effects of pneumolysin in vitro and in vivo and have found that it protects intravenously injected pneumococci from infection-induced host resistance. We employed a virulent capsular type 2 pneumococcal strain, D39, and its isogenic pneumolysin-negative mutant, PLN. Strain D39 exhibited exponential net growth in mice (doubling time of 1.4 h); 24-28 h after infection with 10^4 CFU the numbers of pneumococci reached 10^9 - 10^{10} CFU/ml and the mice died. Strain PLN yielded identical net growth in mice until reaching 10^6 - 10^7 CFU/ml at 12-18 h post-infection. At this time the increase in the level of PLN CFU/ml ceased and remained constant for several days. PLN exhibited wild-type growth kinetics in mice when co-infected simultaneously with strain D39. This observation suggests that pneumolysin exerts its effects at a distance. By 12-18 h post-infection with PLN, mice exhibited the following evidence of an induced inflammatory response: 1) elevated plasma IL-6, 2) a halt in the net growth of PLN, and 3) control of the net growth of pneumolysin-producing D39 pneumococci upon subsequent challenge. Our data suggest that pneumolysin plays a critical role in sepsis during the first few hours after infection by enabling pneumococci to cause acute sepsis rather than chronic bacteremia. However, once chronic bacteremia was established, it appeared that pneumolysin was no longer able to act as a virulence factor.

VISUAL CHARACTERISTICS OF LEGALLY BLIND VETERANS PARTICIPATING IN THE REHABILITATION PROGRAM OF THE SOUTHEASTERN BLIND REHABILITATION CENTER (SBRC) IN BIRMINGHAM, AL. Patti Fuhr, Jeffrey Elliott, and Thomas Kuyk, UAB School of Optometry, and The Department of Veterans Affairs Medical Center, Birmingham, AL

The Department of Veteran's Affairs SBRC is an inpatient, multidisciplinary personal adjustment to blindness program which serves legally blind veterans in the southeastern US. This retrospective study considers the visual characteristics and rehabilitation outcomes of clients over the past 5 years. **Methods:** Records of 669 individuals (96% male) were analyzed by age at admission (under 60 (n=202), 60-69 (n=230), 70-79 (n=189), and 80+ years of age (n=48)), primary cause of vision loss, type of vision loss (legally blind by virtue of acuity or visual field loss only, combination losses, or no useful vision), visual acuity, and ability to access newspaper size (1M) print with any low vision device prescribed. **Results:** Primary cause and visual acuity varied significantly as a function of age groups. Primary type of loss was acuity loss, affecting 54% of the study population. Print access remained fairly steady for all age groups up to 80, (<60 = 92.3%, 60-60 = 91.1%, 70-79 = 88.4%) and even then dropped only to 77% in the 80+ group. There was no correlation between eye disease and success rate. **Significance:** As the legally blind population in this country continues to age, the rehabilitation system must adapt itself to the rehabilitation needs of many more individuals with visual acuity loss (i.e. reading skills and fine motor tasks) and far fewer totally blind individuals. Reading is a primary goal for most individuals, and with training and proper low vision devices, success rates for our client population are high for even the most elderly clients, regardless of the eye disease responsible for vision loss.

AUTOIMMUNE DISORDERS ASSOCIATED WITH UVEITIS (ANKYLOSING SPONDYLITIS, REITER'S SYNDROME, AND SARCOIDOSIS. Stella G. Wong, O.D., Jamie C. Durdin, O.D., Tuscaloosa VA Medical Center, Tuscaloosa, AL 35404.

The term "uveitis" indicates an ocular inflammatory condition of all or parts of the uveal tract, which is composed of the iris, ciliary body, and choroid. Uveitis can be associated with many autoimmune disorders, although this discussion will focus on the three commonly seen at the Tuscaloosa VA Medical Center Optometry Clinic, which are ankylosing spondylitis, Reiter's syndrome, and sarcoidosis. Included in this report are listings of signs and symptoms, diagnostic clinical laboratory tests, systemic and ocular findings, and treatment and management of the uveitis and the associated systemic autoimmune disorders.

ENGINEERING AND COMPUTER SCIENCE

Object-Oriented Neurogenesis: Evolving Application-Specific Feedforward Neural Networks. Mikal Keenan, Dept. of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

In the engineering of neural network software a developer must specify a configuration, generalized adaptation algorithms, and a set of training parameters - then cycle through steps of adaptation, evaluation, and modification. Neural network development is therefore an evolutionary process. The developer embodies evolution, evolving NNs in a trial and error search through a space of possible configurations and parameters with no guarantee of success. Since evolution is responsible for all biological neural systems, collaborations of neural networks and evolutionary computing (genetic search) are biologically plausible and well motivated. Refining the use of such collaborations may decrease the role of trial and error in attempts to modify NN models to suit new problems, and may yield networks with specific capacities difficult or impossible to accomplish using trial and error with other methods. The proposed research will use genetic search as a tool for developing application-specific neural networks. Tools of this type can evolve "smart machines" capable of performing specialized tasks and may replace traditional software engineering techniques for crafting task-specific neural network software solutions. This *neuro-genetic* tool will use *object technology*.

A fine-grained, object-oriented design may yield a flexible and readily-extensible hierarchy of neural components (e.g., *software ICs*) for aggregation and manipulation by genetic operations (evolution). The evolution engine of the system will incorporate adaptive heuristics for neural network design and training. Continued development may incorporate attributes necessary to implement other connectionist models, providing a rich set of component objects for genetic manipulation. Said manipulation may accomplish automated implementation of diverse network models as appropriate for and specific to particular applications. The planned end product is a flexible and readily extensible research/development tool which achieves both network design and training.

USING AN ADAPTIVE PARSER TO CUSTOMIZE A CONSTRAINT-BASED NATURAL LANGUAGE GRAMMAR. Clement S. Allen and Barrett R. Bryant, Department of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

A natural language interface with an adaptive parser can automatically extend the grammar of the interface to accommodate a user's preferred way of expressing queries, thus learning a user's linguistic style. The parser detects and adapts to four kinds of grammatical deviations that may signal a user's preferences: non-standard phrase ordering, new synonyms, phrases with omitted words, and phrases with extraneous words. We describe an adaptive parsing algorithm for a constraint-based grammar formalism, a popular formalism for developing natural language grammars. We present the formal details of the algorithm and demonstrate how it extends a grammar to include a user's linguistic preferences.

DENOTATIONAL SEMANTICS-DIRECTED COMPILER GENERATION FOR OBJECT-ORIENTED LANGUAGES. Prakash K. Muthukrishnan, Dept. of Computer and Information Sciences, Univ. of Alabama at Birmingham, AL - 35294.

The purpose of this research is to facilitate automatic generation of compilers for object-oriented languages from formal specifications. We have developed a language called SmallC++ based on C++ which is a very popular object-oriented programming language. Our SmallC++ language supports object-oriented features like classes, objects, single inheritance and polymorphism through dynamic binding. A continuation semantics, specifying the static and dynamic semantics, of the language is specified. This formal semantics specification is used to guide the compiler implementation. Also a set of sequential combinators is developed to be used in the final code generation. Thus the compiler takes a continuation semantics specification of an object-oriented language and generates sequential combinator code. This approach helps us to automatically generate compilers for object-oriented languages which will translate source programs into equivalent formally provable programs. Our compiler takes a program written in SmallC++ language and translates it into an equivalent ML program that is interpreted by an ML interpreter.

Acknowledgement : This research was supported by a grant from the Alabama Academy of Science. I would like to sincerely thank my advisor Dr. Barrett R. Bryant for his constant help and advice.

DIGITAL TECHNOLOGY, COMPUTERS, AND LANDFILLS. Tola B. Moffett, TTL, Inc., Tuscaloosa, AL 35403. James V. Walters, Univ. of Alabama, Tuscaloosa, AL 35487-0205, and L. Faye Jones, TTL, Inc.

The Alabama Department of Environmental Management determines the suitability of sites for disposing solid wastes. A hydrogeological evaluation is a part of the requirements set forth by the Department for determining whether a site is suitable for a landfill. Depths to ground water and the rate(s) of ground-water flow are determined as part of the hydrogeological evaluations. Geologists and engineers commonly determine the hydraulic conductivities of geological deposits at landfills sites by utilizing electronic data recorders to record the responses of the deposits to sudden changes in the water levels in monitoring wells. The data from these recorders then are downloaded and analyzed with computerized algorithms.

The digital technology and accuracy of the data recorders provide geologists and engineers with the means to gather the data needed to complete the hydrogeological evaluations. Software developed by computer programmers with knowledge of geological conditions and theories of ground-water flow provides geologists and engineers with the capabilities to determine the required rates of ground-water flow. Use of the data recorders and the subsequent analysis of the data with the software packages is described for several hydrogeological settings in Alabama.

Abstracts

ANN CHIPS. Mark Villa, Dept. Computer and Information Sciences, Univ. of Alabama in Birmingham, Birmingham, AL 35294-1170.

CHIPS (Cooperative Heterogeneous Information Processing Systems) in ANN (Artificial Neural Network) form are explored. CHIPS are intelligent, distributed, AI (Artificial Intelligence) systems composed of modules collectively working on one problem. An example of a CHIPS found in nature is the brain, which contains a number of divergent processing and memory modules, which cooperate to solve problems for one human. We construct artificial CHIPS using ANNs, taking advantage of distributed processing environments when available and appropriate.

A typical ANN is monolithic in nature, which tends to leave it out of the realm of CHIPS. Furthermore, while inspired by knowledge of the brain, even non-monolithic ANNs normally have construction details that look first to theory for guidance, and then to current understanding of the brain for rationale, rather than the other way around.

In building CHIPS, we work with a fundamental issues in AI, namely, modeling human cognitive abilities. In particular, the problem of strategy use by children in a structured environment is addressed. Previous modeling work is examined, and description and results of current work are given. The use of the CHIPS paradigm is analyzed relative to the modeling work presented.

PROCESS MIGRATION AND LOAD BALANCING IN HETEROGENEOUS DISTRIBUTED SYSTEMS. Mallikharjun Yalamanchili, Dept. of Computer and Information Sciences, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

In a distributed computing system, the load generated at individual machines can be different, both temporally and spatially, and the overall throughput and response times from the system can be significantly improved if the load is distributed over all the available machines in the distributed system, no matter which node the load is generated at. This process of balancing the load to achieve better performance is called load balancing and it can be achieved statically, dynamically or adaptively. The most logical way to balance load dynamically is to migrate processes from highly loaded nodes to lightly loaded ones thus balancing the load on the distributed system. Process migration is a difficult and cumbersome task in homogeneous distributed systems and gets even more complicated for heterogeneous distributed systems. A process migration mechanism, besides successfully freezing the process on the source node, transferring its state and restarting it on the destination node, must be able to accomplish this task quickly so that the total time taken to migrate the process does not degrade the overall system performance. So far there have been no effective implementations of heterogeneous process migration but there certainly is a need for such implementations. The process migration mechanism being developed at UAB involves migrating the process across heterogeneous platforms by using the process's context and execution state information to translate the process's state on one machine to an equivalent state on another machine. The schema for such a migration mechanism and the various nuances involved will be presented along with a simple hierarchical schema for load balancing in heterogeneous distributed systems.

GROUNDWATER MONITORING FOR MUNICIPAL-SOLID-WASTE LANDFILLS: MANY CHANGES, COSTS INDETERMINATE. L . Faye Jones, TTL, Inc., Tuscaloosa, AL 35403. Tola B. Moffett, TTL, Inc. James V. Walters, Univ. of Alabama, Tuscaloosa, AL 35487-0205.

U.S. Environmental Protection Agency (EPA) regulations that took effect recently already are causing major changes in the disposal of municipal solid waste by landfilling. The regulations, designed to protect groundwater, will impact the economics of landfill disposal strongly (in EPA's words) "by requiring us to pay the true cost of safe landfilling." The landfill rule was promulgated under subtitle D of the Resource Conservation and Recovery Act (RCRA). It establishes federal minimum criteria for municipal-solid-waste landfills (MSWLFs) including location restrictions, facility-design and operating criteria, groundwater-monitoring requirements, corrective-action requirements, financial-assurance requirements, and requirements for closure and for post-closure care. The federal regulations set performance standards which landfill designs must meet and specify the minimum requirements for groundwater monitoring.

This paper is limited to the subjects of groundwater monitoring requirements and the indeterminacy of the costs for them as one tries to estimate what part of the operating budget they will require.

AN APPLICATION OF GRAPH DECOMPOSITION TECHNIQUES TO THE POLYNOMIAL-TIME SOLUTION OF NON-GRAPH PROBLEMS. Eduardo Kortright and Richard Borie, Dept. of Computer Science, Univ. of Ala., Tuscaloosa, AL 35487.

Many previous research efforts have identified graph classes that yield efficient algorithms for otherwise difficult problems. The current research exploits some of these algorithmic techniques, and applies them to difficult non-graph problems that can be expressed in terms of a graph belonging to a certain class, particularly the set of treewidth-k graphs. A variety of problems submit to this approach, of which several examples are used to illustrate the general concepts involved.

ANTHROPOLOGY

PRESTIGE VERSUS WEALTH IN THE CERRO GUACAS POLITY: A SAN AGUSTIN CHIEFDOM SATELLITE VILLAGE OF THE REGIONAL CLASSIC PERIOD IN COLOMBIA. Jeffrey P. Blick, Panamerican Consultants, Inc., 924 26th Avenue East, Tuscaloosa, AL 35404.

This research concerns the emergence of social inequality in chiefdoms. The purpose of this paper is to study the nature and extent of the economic basis of social inequality in chiefdoms in the Valle de la Plata, Colombia. Archaeological evidence in this region indicates that pre-Columbian chiefdoms of the Regional Classic period (A.D. 1-900) were marked by prestige differences reflected in funerary mounds and carved stone statues accompanying the burial of certain persons. The question is: To what extent were these societies also marked by differences in wealth? The critical evidence needed to answer this question comes from residential contexts. This research examines several households in order to compare and contrast their material inventories to discover if wealth differences did exist. The strategy of investigation includes analysis of certain types of ceramics and lithics, taken to represent markers of wealth, plus other artifactual remains, to distinguish if differential access to certain items existed between households. This study concludes that while some wealth differences are distinguishable between households, the differences were quite minor. This finding casts doubt on the popular notion that systems of social hierarchy are based on wealth differentiation or economic differences between groups of people rooted in the control of resources. An alternative system of social differentiation based in the ideological realm is proposed.

Archaeology at the Lyon's Bluff site, a Mississippian and Protohistoric settlement in East Mississippi. Terry Lolley, Panamerican Consultants, Inc., P.O. Box 40930, Tuscaloosa, AL 35404.

The Lyon's Bluff site was first excavated by Moreau Chambers in 1934-35. The site received further attention during the 1960s and 1970s as volunteer and student groups assisted Richard Marshall during archaeological investigations at the site. The lack of a detailed report on the site investigations has hindered the dissemination of data recovered from the site. This paper will attempt once again to draw attention to the site's importance and to present the only complete topographic map made of the site. The site was mapped during the Spring of 1993 with the aid of volunteers from the Cobb Institute of Archaeology, Mississippi State University.

Abstracts

SITE 1BT15: AN ALEXANDER CULTURE OCCUPATION IN THE CUMBERLAND PLATEAU REGION OF NORTHEASTERN ALABAMA. Michael R. Finn, University of Alabama Museums, Office of Archaeological Services, Moundville, AL 35474.

Recent excavations at Site 1BT15 (Smith site) in Blount County, Alabama, have expanded the known temporal and geographic range of the Late Gulf Formational Alexander Culture in northern Alabama. Although the Smith site is a large multi-component site with considerable time depth, the Alexander occupation is the major focus of the prehistoric occupation in the area. A suite of 12 radiocarbon dates obtained from feature contexts shows a temporal range beginning at 930 B.C. and ending at 110 B.C. Diagnostic Alexander ceramics covering almost the entire spectrum of known types were recovered. In addition, a wide variety of both curated and expedient stone tools, including several hundred projectile points, bifaces, drills, and unifacial scrapers, along with scores of hammerstones, grinding stones, and nuttingstones were found. It appears that the Smith site represents a major Alexander occupation in the region. This paper discusses preliminary results of the artifact analysis and presents a series of questions regarding the placement of the site in a broader regional context.

DUST CAVE (1Lu496): AN OVERVIEW OF THE 1989 TO 1994 FIELD SEASONS, Scott C. Meeks and Nurit S. Goldman-Finn, University of Alabama Museums, Office of Archaeological Services, Moundville, AL 35474.

Dust Cave (1Lu496), located in the Pickwick Basin of northwest Alabama, possesses deep, stratified deposits dating from the Late Pleistocene to Mid Holocene. Prehistoric hunter-gatherers occupied the site across a 5,500 year time span. Archaeological excavations revealed a complex microstratigraphy and the presence of abundant preserved organic materials, including bone, shell, and charred botanical remains. The cultural assemblage is complemented by twenty-nine radiocarbon dates, providing additional chronological control for the Late Paleoindian through Middle Archaic periods in Alabama. The following five cultural components have been isolated in Dust Cave: Late Paleoindian (10,500 to 10,000 B.P.), Early Side Notched (10,000 to 9,000 B.P.), Kirk Stemmed (8,500 to 7,000 B.P.), Eva/Morrow Mountain (7,000 to 6,000 B.P.), and Seven Mile Island Phase (6,000 to 5,200 B.P.). A variety of lithic and bone tools indicate a range of activities occurred within the confines of the shelter. This paper presents a synopsis of research in Dust Cave over the past six years, focusing on chronology and artifact assemblages.

Abstracts

Late Postclassic Mayan Architecture of the East Coast of Quintana Roo, Mexico: A Preliminary Report on the Geographic Distribution. Thomas M. Shelby, Dept. of Anthropology, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

Often ignored or mentioned briefly, Late Postclassic architecture of Quintana Roo represents the close of prehispanic Mayan civilization. Even less emphasis has been placed on the distribution of the East Coast, or Tulum, style. The basic characteristics of the style is reviewed, including structural types and decorative traits. A geographical area is proposed, based on the present data we have concerning this area. The majority of sites with buildings in this style are located along the eastern coastline of the Yucatan Peninsula and were built during the Late Postclassic. However, many earlier sites in the interior region have Late Postclassic East Coast style buildings. The large distribution area of the style indicates the extensive networks of trade and ideas that existed during this period.

IDENTIFICATION OF THE KING'S APARTMENT AT IXIMCHE: COMPUTERS AND SETTLEMENT PATTERN ARCHAEOLOGY IN SOUTHEASTERN MESOAMERICA. C. Roger Nance, Dept. of Anthropology, Univ. of Ala. at Birmingham, Birmingham, AL 35294-3350.

In an earlier research paper on the Iximche ceramic collection, the author presented a case that Great Palaces I and II, as described by Guillemin (1977), are actually a temple (G.P. I) and palace (G.P. II). Herein, ceramic data are examined with the aim of determining the locality of the royal apartment within G.P. II. Seven variables are considered, some based on grouped types (ceremonial, utility, etc.) and others on other variables (thickness, paste color, etc.). For each variable, the seven patios were scaled hypothetically from patios reflecting commoner-utilitarian activities to those indicating elite status. A composite scale pointed to Patio NE as the apartment locality, an assignment supported by the distribution of rare and possibly exotic types within G.P. II.

Evolution of the English Land Pattern Musket, Thomas E. Chappelow, Jacksonville State University, Jacksonville, Alabama 36265

This paper will examine the evolution of the English Land Pattern Service Musket, from its earliest forms, which appeared during the second decade of the 18th century, until its obsolescence more than a century later. Also addressed will be the Royal ordinance system and the relation of this famous arm to tactical theories of 18th century warfare.

Abstracts

Phase III Investigation of the Dry Branch Site 1Ca522, Calhoun County, Alabama. Curtis E. Hill, Jacksonville State University, Jacksonville, Alabama 36265

The Dry Branch Site, 1Ca522 is a multicomponent site located within the Coosa Valley Physiographic District in Calhoun County, Alabama. The excavation was funded by a contract with the State of Alabama Highway Department. Early analysis of the artifact assemblage indicates a major occupation of Mid to Late Woodland, however, the entire temporal span reaches from the Late Archaic Period through the Early Historic Period of Northeast Alabama. This paper presents a brief history of the excavation at the Dry Branch Site as well as an interpretation of the artifacts recovered.

STONE MOUND COMPLEXES OF NORTHEAST ALABAMA. Harry O. Holstein, Dept of Geography and Anthropology, Jacksonville State University, Jacksonville, AL 36265.

Regional archaeological surveys and excavations revealed the presence of stone mounds and stone walls throughout Northern Alabama. Data obtained from this research indicates some of the larger stone structures were constructed by Woodland Aboriginal populations for burial cairn. Smaller stone mounds and the stone walls rarely are associated with human remains. Although their exact function remains somewhat unclear, their topographic setting, and absence of associated artifacts and ecofacts suggest these stone structures were, likewise, related to Aboriginal funeral ceremonies.

DEBITAGE ANALYSIS AT THE DRY BRANCH SITE, 1Ca522. Pearl R. Jones, Department of Geography and Anthropology, Jacksonville State University, Jacksonville, AL 36265

Debitage assemblages from the Dry Branch Site (1Ca522) were analyzed using the Sullivan and Rozen classification scheme: complete flakes, broken flakes, flake fragments, and cores. Variables such as size and material were also analyzed. Finally, it was also possible to compare differences in artifact recovery rates between wet and dry screening.

MINUTES
Alabama Academy of Science
Spring Executive Committee Meeting
The Club
Birmingham, AL
March 15, 1995

- A. The meeting was called to order by Dr. Eugene Omasta. The minutes of the Fall Executive Committee Meeting from October 29, 1994, were approved as submitted.
- B. Officer's Reports
1. Board of Trustees - There was no formal report but Dr. Barker did note that 7 members of the Board were present.
 2. President - Dr. Omasta submitted the following list of activities in which he has been involved:
 - a. Coordinated activities of the annual meeting with Dr. Ellen Buckner, Chair, Local Arrangements Committee and Levin Hazlegrove, Executive Director of the Alabama Academy of Science.
 - b. Worked with the Officers, Committee Chairs, and Section Chairs as needed.
 - c. Worked with Dr. Frandsen in support of the proposed Alabama Science course of study.

Up-to-date copies of the following documents are available to you at this meeting.

- (i) AAS Elected Officers, 1994-95
 - (ii) AAS Committees and their Members, 1993-94
 - (iii) Constitution and By-Laws
3. President-Elect - Dr. Dan Holliman reported as follows:

During this year, I have worked closely with the Second Vice-President to select chairpersons and trustees for all elected committees. I have also worked closely with the President in filling appointed committee positions.

I have also been in contact with the other primary officers concerning various problems and projects of the Academy.

Minutes

I particularly commend the work of the Long Range Planning Committee and am in hopes that we can implement some of their recommendations that will be brought to the Executive Committee Meeting.

I look forward to assuming the position of President of the Academy, and will soon be in contact with the various officers in anticipation for another great year.

4. Second Vice-President - Dr. Tom Jandebeur reported that during 1994-95, he:
 - a) attended the Fall Meeting of the Academy, including the meeting of the Steering Committee;
 - b) twice visited with Dr. Richard Hudiburg, Chair, Committee on Research, to discuss responsibilities and functions of that Committee;
 - c) corresponded to officers of four sections of the Academy the need to elect new officers;
 - d) as Chair of the Nominating Committee, developed a slate of nominees for 1995-96 elected officers.
5. Secretary - Larry Boots noted the following members attended the Executive Committee Meeting:

Dan Holliman	Richard Hudiburg
Bill Barrett	Judy McCarley
Larry Ludwick	Priscilla Holland
Adriane Ludwick	Jack Moore
B.J. Bateman	Joe Thomas
Elsie Spencer	Ken Marion
John Frandsen	Larry Boots
Walter Wilborn	Jim Bradley
Gene Omasta	Ellen Buckner
P.C. Sharma	L.S. Hazlegrove
Jerry Burns	Shivendra Sahi
William Osterhoff	Larry Krannich
Betty Bigham	Tom Jandebeur
S.B. Barker	Linda Reed
Mike Moeller	

The summary of membership activities was also presented.

Membership as of March 14, 1995	650
Membership on October 29, 1994	758
Members deleted to non-payment	185
New membership since January 1, 1995	67

Minutes

Trends in membership:	<u>MEMBERS</u>
March 1991	872
April 1992	728
March 1993	661
March 1994	739
March 1995	650

MEMBERSHIP BY SECTION

	<u>SECTION</u>	<u>OCTOBER 1994</u>	<u>MARCH 1995</u>
I.	Biological Science	191	167
II.	Chemistry	73	70
III.	Geology	26	24
IV.	Forestry, Geography, Conserv., Planning	23	24
V.	Physics & Mathematics	104	66
VI.	Industry & Economics	37	24
VII.	Science Education	34	23
VIII.	Social Science	30	35
IX.	Health Science	104	99
X.	Engineering & Computer Science	49	38
XI.	Anthropology	21	9
77.	University Libraries	21	25
88.	High School Libraries	51	51
	UNKNOWN	1	1

MEMBERS

Emeritus	33
High School Libraries	51
University Libraries	25
Honorary	7
Individual	439
Student	65
Life	28
Sustaining	2

6. Treasurer - Dr. Krannich presented an extensive report which is available from the Secretary upon request. The following brief summary is presented:

The Academy operated within the projected 1994 Budget and did not have a deficit due to the significant revenue that was obtained from the 1994 Annual Meeting and decreased expenditures in several categories relative to the budget. Total inflow for 1994 was \$30,793.07 and outflow for 1994 was \$24,203.68. The symposium support funds

Minutes

(\$1,973.03) were from TVA, but were for the Zebra Mussel Symposium in 1993. Dues income for 1994 (\$12,445) was off by approximately \$4,500 as compared with that received in 1993 (\$17,019). The costs associated with the Journal has risen 25% from \$5,482.70 in 1993 to \$6,864.20 in 1994. On the other hand, the Executive Director's expenses were less than budgeted, no workshops received support from the budget, and expenses were held down in a number of categories. In the end, the Academy expended \$7,747 less than projected.

We can expect that Journal costs and Executive Director expenses will be greater that they were last year. We will be paying for a typist for the Executive Director at the rate of \$100/month. Other than that, we appear to be keeping within the budget for 1995.

7. Journal Editor - Dr. Bradley reported that:

Sixteen manuscript were received during the past 12 months. Of these thirteen have been accepted and three were rejected. The number of published abstracts in the July, 1994 issue was 196, down from 235 in 1993.

April, 1994 Issue	-	196 Abstracts Minutes
July, 1994 Issue	-	5 Articles Published Book Review Gorgas Scholarship Competition
October, 1994 Issue	-	4 Articles Published Membership Roll Index
January, 1995 Issue	-	4 Articles Published

8. Counselor to AJAS - Dr. B.J. Bateman submitted the following report:

The Alabama Junior Academy of Science has a full schedule of activities planned for the annual meeting, including: the paper competition among 40 regional winners, local tours, the caucus and the election of state officers, presentation of awards, the joint banquet with the dance, and the Saturday rap session with our banquet speaker, Dr. McClintock.

At this time, 118 students and sponsors have pre-registered for the meeting and 106 plan to attend the joint banquet.

9. Science Fair Coordinator - No Report

10. Science Olympiad Coordinator - No Report

Minutes

11. Counselor to AAAS - No Report

12. Section Officers:

I. Biological Sciences - Stephen Watts presented the following:

The Biological Sciences section will encompass five sessions (four oral half-day and one afternoon poster session) over a two day period during the 1995 meeting of the Alabama Academy of Science in Birmingham, Alabama. A total of 59 presentations will be made during this two-day period, including 41 oral presentations, 6 symposium presentations (Gene Therapy) and 12 poster sessions. For comparison in 1994, 35 oral and 9 poster presentations were made for a total of 44 while in 1993, the numbers were 34 and 20, respectively plus 6 symposium presentations for a total of 60. In 1992, the numbers were 27, 13 and 6 respectively, for a total of 46.

This year represents another good year for the Biological Sciences section, ranking as one of the highest in the last several years. In fact, several presenters were turned away to limited time slots as well as the usual late submissions. There was good participation from many schools, including undergraduates, graduates and faculty. Once again, we see a conspicuous absence of UAT. The section co-sponsored a symposium with Health Sciences entitled "Gene Therapy". Elections will occur at business meeting.

II. Chemistry - No Report

III. Geology - David C. Kopaska-Merkel presented the following:

It has been a good year for the geology section. At the fall meeting, our membership was listed at 25 people, near our stable average for the past several years. The latest list I received from the AAS listed 29 people. I know that several of these people have not renewed their memberships, but several new members have joined us due to pre-meeting recruiting. I believe that our membership stands at about 30 right now. Even more importantly, we have 14 presentations scheduled for our section meeting this week, which is a tremendous increase over recent years. Four institutions are represented, and there will be 5 student presentations. I'm excited about the increased participation, and look forward to next year.

IV. Forestry, Geography, Conservation and Planning - Dr. Holland submitted the following:

The Forestry, Geography, Conservation and Planning Section has 6 papers for the 1995 72nd Annual Meeting. This decrease in papers is due to the conflict with the American Association of Geographer's meeting being held in Chicago March 12-17. This conflict happens on a cyclic basis.

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To increase participation in Section IV, a concerted effort was made to contact foresters, planners and geographers across the state via mail. A letter was mailed to department(s) of geography, forestry, etc. at Colleges and Universities and to agencies (i.e., Alabama Forestry Commission) with information about the Alabama Academy of Science and a call for papers.

Given the response and other contingencies, the Chair would like to request a vote on changing the name of Section IV from Forestry, Geography, Conservation and Planning to **Geography**. As stated in the last report, "Geography, being the all encompassing discipline that is, would accept paper from all the disciplines as before."

V. Physics and Mathematics - No Report

VI. Industry and Economics - No Report

VII. Science Education - No Report

VIII. Social Sciences - No Report

IX. Health Sciences - No Report

X. Engineering and Computer Sciences - No Report

XI. Anthropology - No Report

13. Executive Officer - Dr. Leven Hazelgrove submitted the following report:
Since the Fall Executive Meeting, 10-29-94, UAB, we have been working on the following projects during the last 5 months:

1. Set up and ran the Gorgas Scholarship Foundation, Inc., Science Talent Search in cooperation with the Westinghouse Scholarship Ranking Service, Inc. D.C. at the UAB meeting, March 17, 1994, with the leadership of Dr. Glynn Wheeler, Section Treasurer and Dr. Douglas Watson, UAB.

2. Mailed by bulk mail nearly 850 UAB meeting programs for March 15-18, 1995 edited by Dr. William J. Barrett, February 20, 1995.

3. Sent development letters to 4 industrial companies and foundations with positive reply from one.

4. Assembled, edited and prepared for bulk mail 900 UAB "Call for Papers" for UAB meeting March 15-18, 1995, with the able assistance of Ms. Amie Stephens, Microbiology, UAB, 934-4027.

Minutes

5. Sent hand written notes to 50 outstanding Scientist and Engineers, Mathematicians, and potential members whose "write-up" appeared in local publications (Twenty New Members!!).
6. Met five times with Dr. Ellen Buckner, Prof. of Nursing, UAB, 934-6799 and her local committee for the *1995 AAS dates: March 15-18, 1995, UAB*.
7. Set up and ran the ASTA booth at UAB Arena, September 8-9, 1994 with the able assistance of Dr. William J. Barrett, Dr. Dan Holliman, Ms. Melanie Sessions and Dena Byars, TSU.
8. Prepared 350 abstract forms for the UAB meeting, March 15-18, 1995 for eleven section chairs and Symposium on Gene Therapy with Dr. Jerry N. Thompson, (Prof. Biochemistry and Medical Genetics, UAB).
9. Move the AAS Executive Director's office to 281 Bevil Biomedical Research Building (BBRB 281); new phone (205) 934-6729, FAX (205) 934-9256.
10. Your Director will be studying flora, fauna and pollution in Alaska, USA, September 3-10, 1995.
11. Set-up the 73rd Annual Meeting with the able direction of Dr. Adriane Ludwick, Prof. of Chemistry, Tuskegee University, Tuskegee, AL, 6 March -9, 1996, Kellogg Center.
12. Set-up with Dr. David Nelson's able help the 1997 meeting at AUM with a kind invitation of Chancellor Roy H. Saigo and local chairperson Dr. Alan Hackel, Dean of Continuing Education, (205) 244-3343.

C. Committee Reports

1. Local Arrangements - Ellen Buckner reported that:

The Local Arrangements Committee welcomes you to the meeting on the UAB Campus. Scientific sessions and social events are listed in your program notes and room changes will be located on 2nd floor concourse, Education Building.

For the first time, exhibitors will present displays. There will be available Thursday on the 2nd floor concourse. I encourage your participation in the Symposium "Gene Therapy in Human Disease" on Friday morning at the Hill University Center.

Parking for the Joint Banquet on Friday evening will be available at the lot adjacent to Hill University Center, Great Hall. Tickets may be purchased through Thursday morning registration.

Minutes

Welcome! Please let us know if we can assist you further.

2. Finance - Dr. Barker summarized the Academies finances in the following report:

As in previous years, to give an overall perspective, I have tabulated Income and Expenditures for 1992 through 1994 at Fall Executive Committee Meeting time and then after completion of each full 12-month period. You can see that sizable (and even scary) deficits ended up as small positive balances. Since our 1994 October deficit was the smallest in three years, I suggested the complete 1994 year might again end in the black, and invited members to come to the 1995 Spring Meeting to find out; as you can see from the table, we ended with the largest balance in 3 years, nearly \$6,600.

As Dr. Krannich pointed out, this was due to an increase in meeting income and a decrease in Executive Director's expenses. As mentioned, these are not expected to continue, and a small deficit is again projected for 1995. I should again point out, as done in previous years, the great variability from quarter to quarter in our finances, caused by a peak of Academy activity every Spring. The presence of a slight positive balance for the first two and a half months of 1995 does not really serve as a forecast for the entire year ahead.

Again, the Committee on Budget and Finance wishes to commend our Treasurer for his stewardship of our affairs.

3. Membership - No Formal Report
4. Research - Dr. Hudiburg reported that:

The Chairperson of the Committee on Research received 56 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards. The later deadline of **February 1** seems to have generate more requests. There was little difficulty in processing these requests. There was some confusion by some of the requesters to where they should direct the request. It is requested that members advise their students to the correct procedures for apply for these competitions. Some requests were received after the deadline and these applicants were not allowed to participate.

Nine travel grants were awarded. A total of 30 papers and 6 posters, covering 7 of the AAS Sections, are entered in the Student Research Award Competition. There are 13 applications for the Student Research Grants. The section Vice-Chairpersons will provide the names of his/her competition winners to the Chairperson of the Committee on Research before the annual meeting banquet scheduled for March 17. The awards in a section can be split between co-winners according to the decision of the judges.

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It is requested that email addresses for all officers and chairs of AAS Committees be provided if available. The chairperson has found this to be an efficient way to communicate. I will request that my email address be added next year to the call for papers in order to facilitate communication.

5. Long-Range Planning - Dr. Marion submitted this committee's report:

In response to directives delivered to the Long-Range Planning Committee by President Omasta at the Fall 1994 Executive Meeting, the Committee has explored the following:

1) Whether we should continue our membership in the National Assoc. of Academies of Science (NAAS); and 2) What are the appropriate number of issues to make **The Journal** viable.

Membership in the National Association of Science:

We now pay \$120/year. Nearly all state academies are listed as members, and there is a directory of officers and leaders for each state that is sent to the state president each year (usually one year behind when it comes). Also in this booklet are abstracts of Jr. Academy papers presented at the Annual Meeting (held in conjunction with AAAS meeting). To our knowledge, we have not sent anyone in recent years to the NAAS Meeting. We concluded that this is a resource of information for us. It has been used in the past to ask questions about how other state academies are structured, etc. It may be valuable at various times to have this resource. In addition, the Committee felt that we simply need to be listed along with all other state academies. *The Committee recommends keeping our membership in NAAS.*

Appropriate Number of Issues for The Journal:

The publication of *The Journal* is a major budget item for the Academy. Four issues/year has been the traditional format. Occasionally, we have combined issues, so that only three issues were printed. We have also had some difficulty receiving enough manuscripts to produce four issues of adequate size. The Committee considered potential negative perceptions of a reduced number of issues weighed against budgetary benefits. The Committee feels that the number of issues can be reduced from four/year and recommends that the Academy consider such action. There were varying options as to how many issues could be eliminated and *The Journal* still remain "viable".

Other issues for consideration were raised by the Committee before the Fall Executive Committee Meeting. These were:

1) The possible establishment of an Exhibitors Committee. This year's meeting will feature some exhibitors. Such a committee could seek several exhibitors to attend annual meetings. It could provide year-to-year continuity to assist the Local Arrangements

Minutes

Committee. In addition, it could be a possible source of meeting revenue. *The Committee recommends that, contingent upon the response from this year's meeting, the Academy consider establishing an Exhibitor's Committee.*

2) *A drive to increase manuscript submissions for The Journal.* The Committee recognizes that efforts have been attempted before. *The Committee has no specific recommendations here except to continue to publicize to our members that The Journal is available for submission of manuscripts.*

3) *A permanent office for the Academy.* We have been fortunate to have support from Dr. Cassell. We are budgetarily limited as to what we can do. *However, The Academy should continue to explore possibilities.*

6. Auditing - Sr. Academy - Dr. Poirier reported the following:

This is a report of the AAS Auditing Committee for the period from 1/1/94 to 2/20/95. I have examined the accounting records provided by AAS Treasurer, Dr. Larry K. Krannich. I am satisfied that the receipts and expenditures, as presented, are correct and that all expenditures are legitimate expenses.

The Audit Committee appreciates the time and effort Dr. Krannich has devoted to these records.

7. Auditing - Jr. Academy - No Report

8. Editorial Board and Associate Journal Editors:

I am pleased to report that 14 Benefactors of the *Journal* have contributed \$4,550 this past year to help defray publication costs. I continue to look for ways to increase the number of Benefactors of the *Journal*.

9. Place and Date of Meeting - Dr. Nelson reported that he was proceeding as follows

:

(March 6-9)	1996 Tuskegee University
(late March-early April)	1997 Auburn University, Montgomery
	1998 University of South Alabama

We should have a letter of invitation from the University of South Alabama. I apologize for the delay but want to keep everyone informed.

10. Newsletter - No Report

11. Public Relations - No Report

Minutes

12. Archives - No Report

13. Science and Public Policy - Dr. Frandsen and his committee have been very active and have submitted a lengthy report which will not be reprinted here. Anyone interested in the full report may request a copy from the Secretary. Their efforts are more or less summarized by a proposal submitted for publication and will be discussed under New Business.

14. Gardner Award - No candidates were considered this year.

15. Carmichael Award - Dr. Sahi reported that:

The Emmett B. Carmichael Award Committee has recommended the article "Feeding rails with the Dusky Gopher Frog, *Rana capito sevosa*, in a Recirculating Water System and Other Aspects of their Culture as a part of a 'Headstarting Effort' by Dr. Malcom R. Braid, Mr. Charles B. Raymond and Mr. Wallace S. Sanders as an outstanding paper published in the journal in 1994.

16. Resolutions - No Report

17. Nominating Committee - Dr. Jandebeur submitted the following names for officers of the Academy:

President.....	Dr. Dan Holliman
First Vice-President.....	Dr. Tom Jandebeur
Second Vice-President.....	Dr. Ellen Buckner
Secretary.....	Dr. Larry Boots
Treasurer.....	Dr. Larry Krannich
Editor.....	Dr. James Bradley

Associate Counselor to the Junior Academy.....	Betty Bigham
---	--------------

Coordinator of State Science Olympiad.....	Dr. Steven Carey
Counselor of the AAAS.....	
Trustees.....	William T. Barrett Philip Beasley Elsie Spencer

18. Mason Scholarship - Dr. Moeller reported that seven applicants had been considered and the scholarship has been offered.

D. Old Business

Minutes

E. New Business

1. A motion to change the name of Section IV to "Geography was passed"
2. A motion to retain memberships and pay dues to NAAS passed.
3. A motion to pay AAAS dues for the AAAS Representative passed.
4. There was discussion concerning the number of issues of the Journal. It was decided that the editor could determine this.

5. The Science and Public Policy Committee submitted the following statement for adoption by the Executive Committee:

We are members of the Executive Committee of the Alabama Academy of Science express our profound disapproval of the unwarranted personal interference by the Governor of Alabama in the proceedings of the Course of Study: Science Committee March 8, 1995. This interference allowed persons, neither educators nor scientists, who were opposed to adoption of the Course of Study: Science, as drafted, to enter a "close" meeting of the Committee, to therein make their objections known, and to cause the Committee to make changes in the draft to address these objections. These changes then became a part of the Course of Study: Science adopted by the State Board of Education, to the detriment of its quality and the quality of the process of science education it mandates.

[If adopted, statement would not be released to the press until after the Governor fills the remaining vacancies of the Textbook Selection Committee.]

This statement passed.

There being no further business, the meeting was adjourned.

REPORT ON THE GORGAS SCHOLARSHIP COMPETITION, 1995

Today the Gorgas Scholarship Foundation, Inc. announced the ranking of the finalists in the 1995 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at the University of Alabama at Birmingham in Birmingham, Alabama.

The winner of the first-place tuition grant of \$2500 was

Keith Eric Gipson, 120 - 9th Street, NE, Leeds, AL 35094.
Alabama School of Fine Arts. Traci Allen - Teacher.

First alternate and winner of a \$1500 tuition grant was

Nataly Marie Morgan, 207 Padgetts Road, Seale, AL 36875.
Glenwood High School. Pamela Ray - Teacher.

Second alternate and winner of a \$1000 tuition grant was

Jennifer Pan, 2231 Montreat Drive, Birmingham, AL 35216.
Vestavia Hills High School. Jim Shoemaker - Teacher.

Third alternate was

Steven Cosme Reutter, 2103 Edwards Avenue, Muscle Shoals, AL 35661.
Wilson High School. Melonie Hanson - Teacher.

Fourth alternate was

Anne Katherine Holloway, 106 Linda Lane, Florence, AL 35630.
Bradshaw High School. Cynthia R. Tillery - Teacher.

Fifth alternate was

(S) Michael Darragh Flannery, 403 Laurel Oak Drive, Muscle Shoals, AL 35661.
Bradshaw High School. Toni Sellars Lindler - Teacher.

Sixth alternate was

Daniel Ernest Haggstrom, Route 8, Box 119, Florence, AL 35630. Bradshaw High School. Toni Sellars Lindler - Teacher.

Seventh alternate was

Gorgas Scholarship

(S) Joshua Adam Davis, Route 4, Box 287, Opp, AL 36467.
Kinston High School. Angela Marie Baker Sasser - Teacher.

Eighth alternate was

(S) Robert Andrew Murray, 433 Nottingham Road, Florence, AL 35630.
Bradshaw High School. Cynthia R. Tillery - Teacher.

Unable to be present for the final presentation of projects and interviews were

Jennifer Caroline Self, Route 6, Box 563, Florence, AL 35633.
Bradshaw High School. Cynthia R. Tillery/Carolyn Ect - Teachers.

Jeffrey James Megher, Route 8, box 629, Florence, AL 35630.
Bradshaw High School. Toni Sellers Lindler - Teacher.

The ranking were established by a panel of judges consisting of department heads, deans, and professors from many of the leading universities and industries in Alabama.

Winners and finalists in the Gorgas Contests receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Foundation is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the U. S. Army. The purposes of the Foundation are to promote interest in science and to aid in the education of promising students.

(S) = Semifinalist in the 54th Westinghouse Science Talent Search

The Chairman on the Judges:

L. S. Hazlegrove
208 Rockaway Road
Birmingham, AL 35209
GORGAS SCHOLARSHIP FOUNDATION
1-205-879-0004, UAB 1-205-934-6729

ALABAMA JUNIOR ACADEMY OF SCIENCE

Most with the Least Award

Biology - Karen Jones - The Isolation and Identification of Bacteria in Four Soil Types in Madison County - West Region - Sumter County High School

Humanities - Andrea Harmon - Has Society Accepted Males Wearing Long Hair? Southeast Region - Handley High School

Engineering - Mark Spencer - Design, Modeling, and Fabrication of a Liquid State Dynamic Resistor - Southeast Region - Auburn High School

Mathematics - Jeffrey Meagher - The identification of Bird Species through the Recognition of Their Unique Acoustical Patterns: A Feasibility Study - Northwest Region - Bradshaw High School

Physical Science - Stephanie Brown - The Removal of Soil Contamination On-Site - North Region - A. P. Brewer High School

Second Place Award

Biology - Joshua Davis - A Partial Purification of a Mitochondrial DNA Topoisomerase of *Saccharomyces cerevisiae* - South Region - Kinston High School

Humanities - William Hankins - The Relationship Between Caffeine Consumption and Athletic Performance in Young People - Northwest Region - Bradshaw High School

Engineering - Steven Reutter - Structural Integrity of Double-decker Highways in Unstable Soils During Earthquake Stress - Northwest Region - Wilson High School

Mathematics - Jeffrey James Meagher - The Identification of Bird Species through the Recognition of Their Unique Acoustical Patterns: A Feasibility Study - Northwest Region - Bradshaw High School

Physical Science - Nicholas S. Hare - Investigating the Effect of Wing Vortices - Southeast Region - Handley High School

First Place Award

Biology - Wade Taney - Determination of the Effects of Metabolic Breakdown on the Mutagenicity of Caffeine - North Region - A. P. Brewer High School

Alabama Junior Academy of Science

Humanities - Heather McNeill - Controlled Dietary Treatment of Rumination and Associated Weight Loss in an Adolescent with Autism - Central Region - Shades Valley Resource Learning Center

Engineering - Mark Spencer - Design, Modeling, and Fabrication of a Liquid State Dynamic Resistor - Southeast Region - Auburn High School

Mathematics - Chris Beasley - Information Theory, Quantum Mechanics, and the Linear Harmonic Oscillator - North Region - Athens High School

Physical Science - Jeffrey Lamarque - Detection of Heavy Atom Derivatives of Protein Crystals - Central Region - Shades Valley Resource Learning Center

Grant for Research Projects

Salina Carlisle Camillia Ruffin	Sumter County High	\$100.00
------------------------------------	--------------------	----------

AAAS Award

Jason Courson	RLC
---------------	-----

Outstanding Region

Northwest

Outstanding Teacher and Audubon Workshop Scholarship

Mary Thomaskutty

Newly Elected Officers for 1994-95

President	Michael Hallisey	Shades Valley Resource Learning Center
Vice-President	Scott Buckelew	Opp High School
Treasurer	Jason Jones	Brooks High School
Secretary	Amanda Bullard	AP Brewer High School

Notes

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INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. Larry R. Boots, Department of Obstetrics & Gynecology, University of Alabama, Birmingham, AL 35294. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics; Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the *Journal* implies that it has not been published previously and that it is not currently being considered for publication elsewhere.

Submission: Each manuscript will receive at least two simultaneous peer reviews. Include in your letter of transmittal the names, addresses, and telephone numbers of at least four qualified referees. Do not include names of individuals from your present institution.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. Submit the original and two copies to the Editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. An abstract not exceeding 200 words will be published if the author so desires. Use headings and subdivisions where necessary for clarity. Common headings are: Introduction (including a literature review), Procedures (or Materials and Methods), Results, Discussion, and Literature Cited. Other formats may be more appropriate for certain subject matter areas. Headings should be in all-caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. Do not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under Literature Cited. Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text by number or by author-date.

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July 1995



COVER PHOTOGRAPH: Mangrove rivulus (*Rivulus marmoratus*) is the only vertebrate species that normally reproduces by self-fertilization. This hermaphroditic fish is an inhabitant of mangrove swamps and has several adaptations for survival in temporal pools and burrows of land crabs. Mangrove rivulus is also an excellent laboratory animal and is used in carcinogenesis and genetics studies.

Arunthavarani Thiagarajah is currently a Research Assistant Professor in the Department of Environmental Health Science, School of Public Health and Tropical Medicine, Tulane University Medical Center, New Orleans, Louisiana. John M. Grizzle is a Professor in the Department of Fisheries and Allied Aquacultures at Auburn University.

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MORPHOLOGY OF LIVER, GALL BLADDER, AND PANCREAS IN THE
SELF-FERTILIZING FISH, *RIVULUS MARMORATUS*
(CYPRINODONTIFORMES: APLOCHEILIDAE)

Arunthavarani Thiyagarajah² and John M. Grizzle³
Department of Fisheries and Allied Aquacultures
Auburn University, AL 36849

ABSTRACT

The liver, gall bladder, and pancreas of mangrove rivulus (*Rivulus marmoratus*) were described by light and electron microscopy. Although hepatic lobules are not sharply delimited in mangrove rivulus, functional lobules are arranged around central veins and demarcated peripherally by portal veins cuffed by exocrine pancreas. Nuclear accumulations of glycogen, lipid, or both glycogen and lipid are common in hepatocytes. Intrahepatic bile ducts were not seen until after the fish were 3 months old, and intrahepatic bile ducts were scarce in adults. Stellate cells, containing lipid droplets and microfilaments, are present in the perisinusoidal space. Exocrine pancreatic tissue is diffusely distributed and is present in the wall of the spherical gall bladder. Endocrine pancreas consists of one principal islet plus smaller islets. The pancreatic islets were embedded in exocrine pancreas but were not present in association with the exocrine pancreas in the liver and gall bladder.

INTRODUCTION

There are differences in the histologic and ultrastructural features of normal liver, gall bladder, and pancreas of different fish species (Hale 1965; Chakrabarte et al. 1973; Harder 1975; Grizzle and Rogers 1976; Eurell and Haensly 1982; Hinton et al. 1984). Some prominent differences include the arrangement of hepatocytes, the amount of pancreatic tissue within the liver, and the degree of pancreatic dispersion.

¹Manuscript received 11 January 1995; accepted 8 February 1995.

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Mangrove rivulus (*Rivulus marmoratus*) is a self-fertilizing hermaphroditic fish (Harrington 1961) typically found in brackish water, but that can survive in fresh water or sea water. Mangrove rivulus is an excellent laboratory animal because it is small (usually 3-4 cm total length), hardy, and easily bred all year. Mangrove rivulus are used in carcinogenesis studies (Koenig and Chasar 1984; Thiyagarajah and Grizzle 1986a; Park et al. 1993; Goodwin and Grizzle 1994) and have potential use in mosquito control (Taylor et al. 1992), genetics (Turner et al. 1990), acute toxicity tests (Park et al. 1994), and teratology (Davis 1988; Park et al. 1992). Mangrove rivulus are also of interest because they are the only vertebrate species that is normally self fertilizing (Harrington 1961) and because of their adaptations for survival in temporal pools in mangrove habitats (Grizzle and Thiyagarajah 1987; Davis et al. 1990).

Although knowledge of normal structure is important to interpret morphologic alterations in experimental studies, the liver, gall bladder, and pancreas of mangrove rivulus have not been described. The objective of this study was to describe the distinctive features of these organs in mangrove rivulus.

MATERIALS AND METHODS

Monthly samples of laboratory reared mangrove rivulus, from 1 day old to 18 months old, were fixed as whole specimens in 10% buffered formalin, Bouin's fixative, or Carnoy's fixative. Whole specimens were decalcified in a formic acid-citrate mixture and embedded in paraffin. Serial sections were cut 5 μ m thick (transverse, sagittal, and frontal sections) and stained with hematoxylin and eosin. Azan, Luna Ishak, Masson's trichrome, Gomori's reticulin (Humason 1979), and periodic acid-Schiff (PAS; Luna 1968) stains were employed on selected sections.

For embedding in plastic for light microscopy, liver was fixed in formalin, postfixed in 1% osmium tetroxide for 2 hours and then washed in two changes of phosphate buffer for 20 min. Tissues were dehydrated in a graded series of ethanol, infiltrated in JB-4 plastic embedding medium (Polysciences, Warrington, Pennsylvania) and embedded in catalyzed JB-4 solution. Sections were cut 2 μ m thick and stained with PAS and hematoxylin.

To demonstrate the presence of lipids, whole fish or the entire viscera were frozen (-15°C) and sectioned 8 μ m thick. These sections were stained with oil red O.

For electron microscopy, liver was fixed in 2.5% glutaraldehyde for 4 hours, postfixed with 1% osmium tetroxide, dehydrated in a graded series of ethanol, and embedded in epoxy. Sections were cut 60 μ m thick with an ultramicrotome and contrasted with uranyl acetate and lead citrate.

RESULTS AND DISCUSSION

Liver

The liver of mangrove rivulus is a single mass with a slightly elongated posterior projection on the right side. It is bordered anteriorly by the transverse septum, posteriorly by the intestine, laterally by parietal peritoneum and lateral muscles, dorsally by the esophagus, and ventrally by the abdominal wall. Color of the liver is variable, probably dependent on glycogen and lipid content of hepatocytes. The entire liver is covered by peritoneum and is attached to the transverse septum by a ligament. Macrophage aggregates occur in adult mangrove rivulus and can be induced by parasites (Vogelbein et al. 1987). Hematopoietic tissue is not present in the liver.

Histologically, the liver is composed of anastomosing tubules or two-cell-thick laminae of hepatocytes (Fig. 1). The most obvious tubular pattern has hepatocytes radially arranged around a sinusoid. This pattern also occurs in Atlantic croaker,

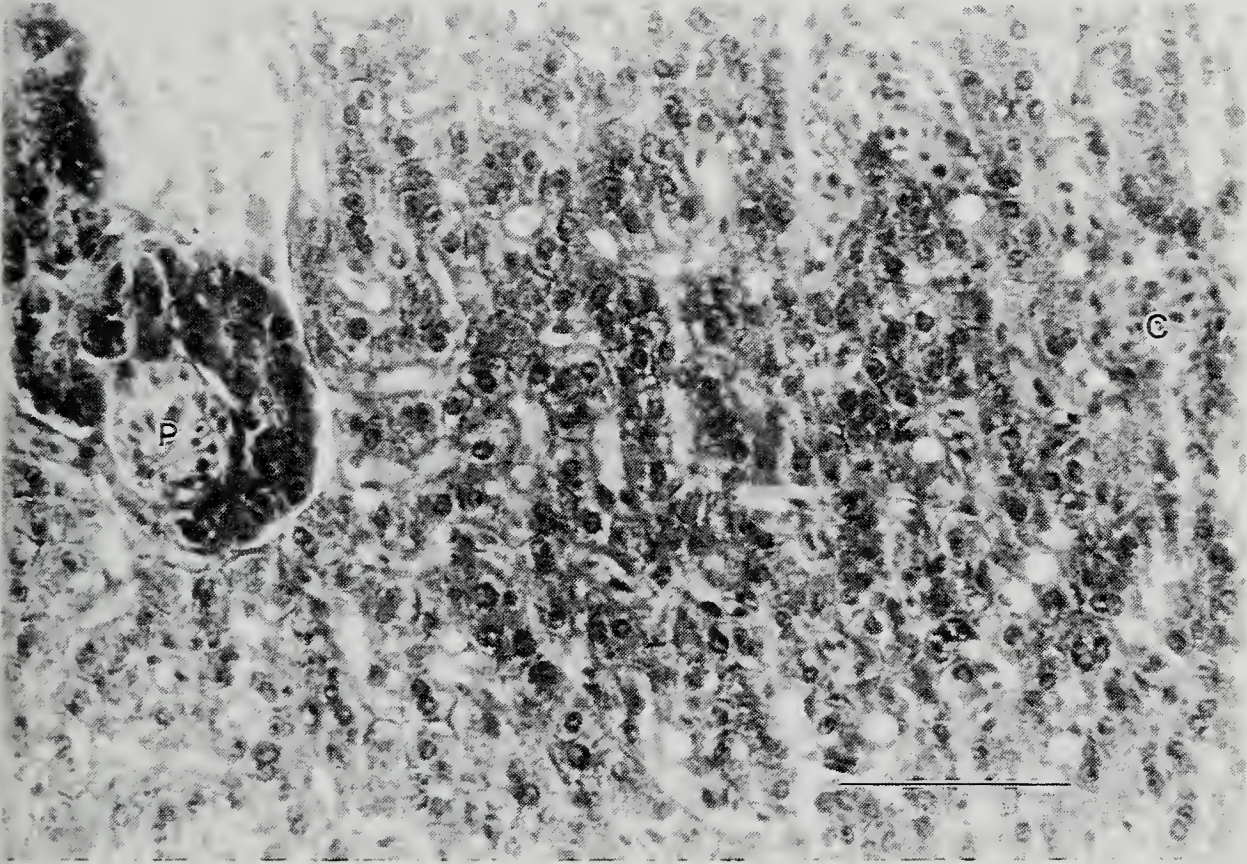


Figure 1. Paraffin section of mangrove rivulus liver. Central vein (C) and portal vein (P) surrounded by exocrine pancreas. Hematoxylin and eosin. Bar = 50 μ m.

Micropogon undulatus, (Eurell and Haensly 1982) and grey mullets, *Liza* spp., (Biagianti-Risbourg 1991). In salmonids, hepatic tubules have a bile canaliculus or bile preductule in the center (Hampton et al. 1985, 1988; Rocha et al. 1994; Speilberg et al. 1994); additional study will be required to determine if this type of tubular pattern also occurs in mangrove rivulus.

Liver of mangrove rivulus does not have morphologically distinct lobulation as in mammalian liver. However, functional lobules are present with blood flow from peripheral portal veins to the central vein in the core of each lobule (Fig. 1). In adults, the portal veins are often cuffed by exocrine pancreas.

Hepatocytes are polygonal cells containing a centrally located, basophilic, spherical nucleus with a prominent nucleolus. Most of the cytoplasmic organelles are often concentrated near the nucleus or near the plasma membrane because of cytoplasmic accumulations of lipid and glycogen. The relative abundance of cytoplasmic glycogen and lipid varied between fish.

Ultrastructurally, hepatocyte cytoplasm contains alpha glycogen either as individual particles or as clumps surrounding lipid droplets (Fig. 2). Mitochondria, lysosomes, and rough endoplasmic reticulum (RER) are present mostly as a nuclear cuff or marginated near the plasma membrane. Occasionally, myelin whorls were present in hepatocyte cytoplasm.

Nuclear vacuolation was common and was caused by accumulation of glycogen, lipid, or both glycogen and lipid (Thiyagarajah and Grizzle 1986b). Nuclear vacuoles that are PAS positive occur in hepatocytes of largemouth bass, *Micropterus salmoides*, (Hibiya 1982), but both glycogen and lipid in the same nucleus have not been reported in other fish or mammalian species.

Hepatic sinusoids are lined by a discontinuous layer of hyperchromatic endothelial cells. Ultrastructurally, each endothelial cell contains long cytoplasmic processes and a small elongated nucleus. The cytoplasmic processes contain small vesicles and a few microfilaments near the plasma membrane. Mitochondria, smooth endoplasmic reticulum (SER), RER, and Golgi complex are also present. A basal lamina was not observed beneath the endothelial layer.

Kupffer cells were not identified in paraffin sections of liver unless the fish had been intraperitoneally injected with India ink. Ultrastructurally, Kupffer cells contain many lysosomes, phagocytized materials, mitochondria, SER, and RER. Kupffer cells are attached to the endothelial layer by desmosomes and project into the sinusoidal lumen. Some fish species may not have Kupffer cells (Robertson and Bradley 1992), but perisinusoidal macrophages are probably present in some of these species (Rocha

et al. 1994). Cells similar to Kupffer cells have been termed resident sinusoidal macrophages by some authors (Hampton et al. 1987).

Ultrastructurally, the perisinusoidal space contains microvilli, collagen, reticulin, and stellate cells (Fig. 3). Stellate cells contain lipid droplets and microfilaments and appear similar to those in other fish (Robertson and Bradley 1992; Rocha et al. 1994; Speilberg et al. 1994). Perisinusoidal stellate cells have also been termed fat-storing cells, Ito cells, or lipocytes (Ramadori 1991). In mammalian livers, stellate cells play an important role in vitamin A metabolism and hepatic fibrosis.

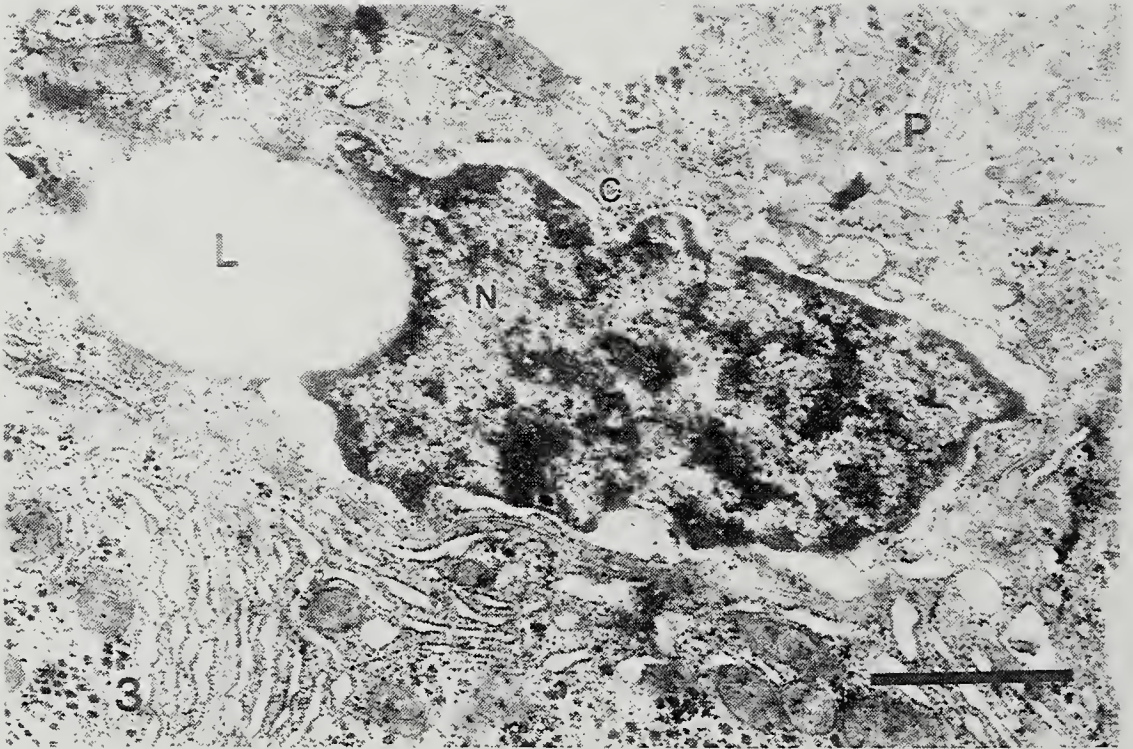
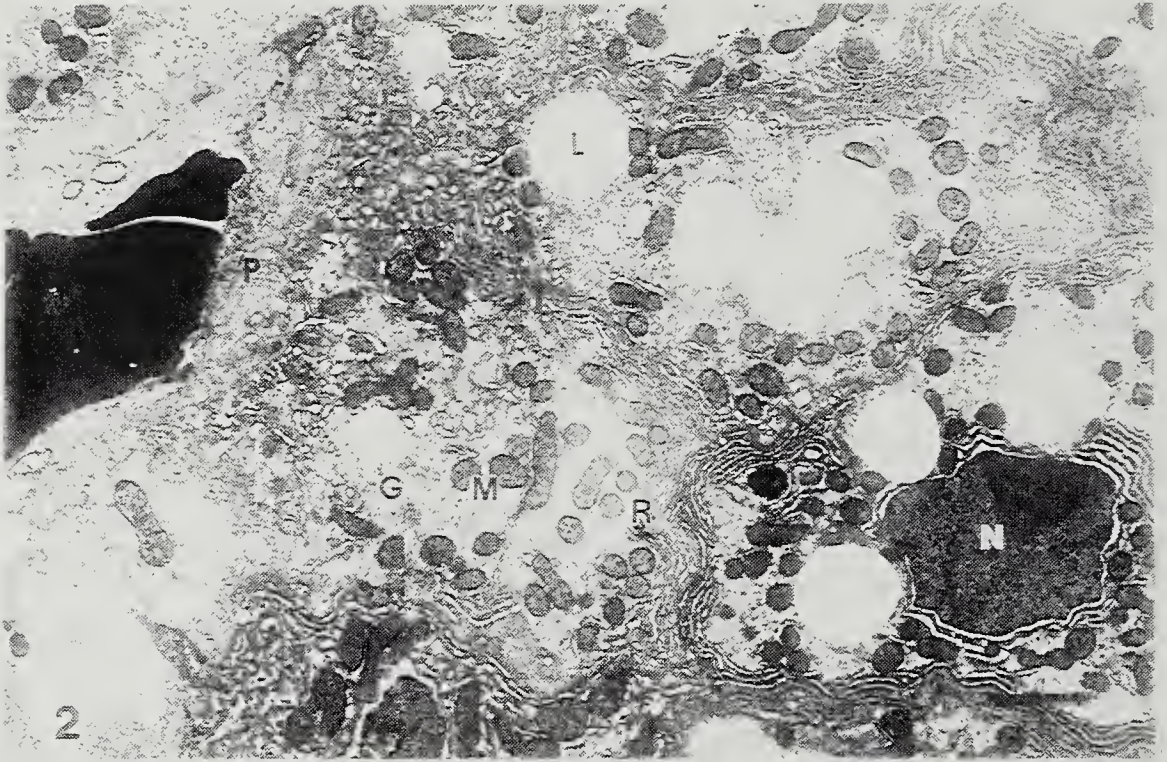
Bile canaliculi are formed by three to six adjacent hepatocytes and contain microvilli projecting into the lumen. The pericanalicular zone of hepatocyte cytoplasm is rich in microfilaments and vacuoles. Bile canaliculi continue as preductules and then ductules that open into small bile ducts near the hepatic portal vessels. Preductules are lined by flattened epithelial cells with no fibrous tissue, whereas ductules are lined by cuboidal epithelium with sparse fibrous tissue around it. Ultrastructurally, each ductule cell contains a large oval nucleus and a thin layer of cytoplasm with few cytoplasmic organelles. The bile ducts are lined by cuboidal epithelium and have a moderate amount of collagen. No intrahepatic bile ducts were seen in 1-day-old to 3-month-old mangrove rivulus, and adults have only two to four bile ducts per median sagittal section of the entire liver. Hale (1965) found few intrahepatic bile ducts in the guppy, *Poecilia reticulata*, which is in the same order as mangrove rivulus.

Several small bile ducts from the liver join to form the right and left hepatic bile ducts. These two ducts join together to form the cystic duct that opens into the gall bladder neck. The cystic duct has folded cuboidal to low columnar epithelium.

Gall Bladder

The gall bladder is a spherical sac located on the posterior surface of the liver. The common bile duct from the gall bladder opens into the anterior part of the intestine just posterior to the esophagus (the stomach is absent) along with the pancreatic ducts. Although the bile and pancreatic ducts are surrounded by a single connective tissue sheath, there is no connection between lumens of these ducts.

Histologically, the gall bladder wall is composed of four layers: mucosa, submucosa, muscularis, and serosa. The mucosa is composed of a simple cuboidal to low columnar epithelium. The submucosa contains dense connective tissue containing types I and III collagen fibers. The muscularis is composed of irregularly arranged smooth muscle and collagen. In most specimens, exocrine pancreas, located



Figures 2-3. Electron micrographs of mangrove rivulus liver. Bars = 1 μ m. Figure 2. Hepatocytes with glycogen (G), mitochondria (M), lipid droplet (L), nucleus (N), endoplasmic reticulum (R), perisinusoidal space (P). Figure 3. Stellate cell (C) in the perisinusoidal space (P). Nucleus (N), lipid (L).

between the serosa and muscularis, was continuous around the gall bladder (Fig. 4). The simple squamous epithelium of the serosa covers the gall bladder. Histologically, the common bile duct is similar to the gall bladder.

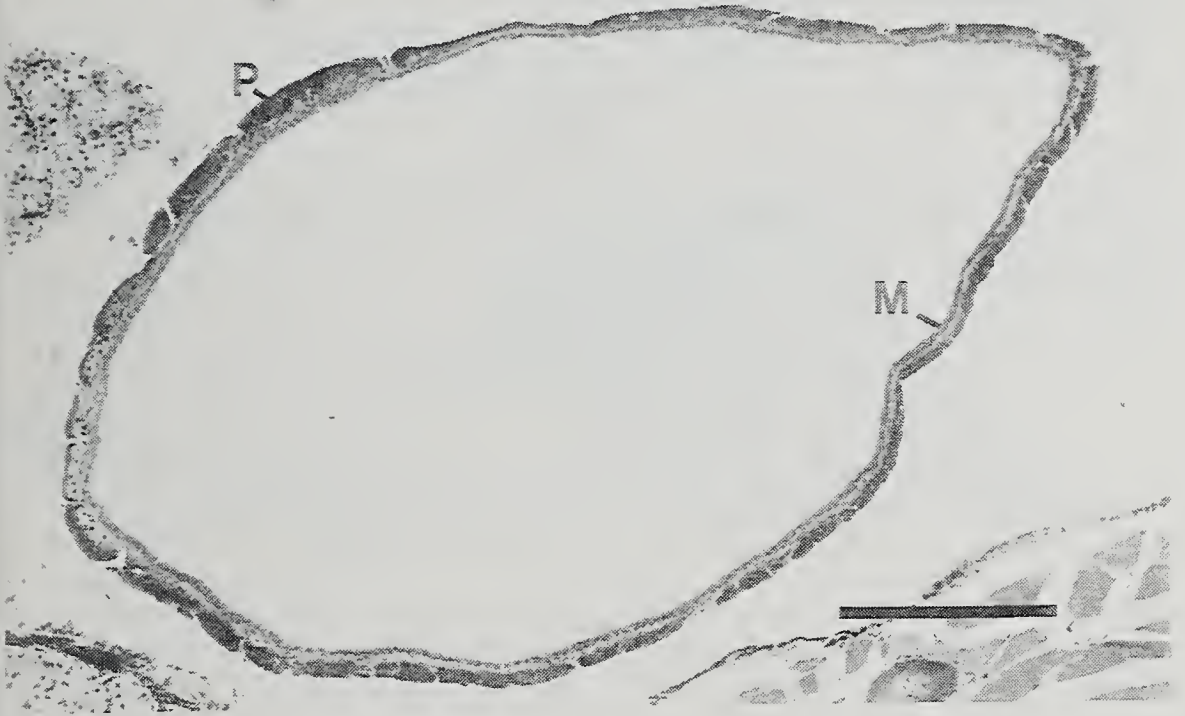


Figure 4. Paraffin section of mangrove rivulus gall bladder, which contains pancreatic acini (P). Gall bladder mucosa (M). Hematoxylin and eosin. Bar = 200 μ m.

Exocrine pancreas in the gall bladder wall occurs in a few families of fish including Cyprinidae, Siluridae, Nandidae, Clariidae, and Bagridae (Chakrabarte et al. 1973). The distribution of pancreas in the gall bladder is similar in mangrove rivulus and guppies (Hale 1965).

Pancreas

As is typical for teleosts, the pancreas in mangrove rivulus does not form a compact organ. Exocrine pancreas is diffusely distributed in the mesenteries, especially near portal veins and bile ducts (Fig. 5). As previously noted, exocrine pancreas is also located in the wall of the gall bladder and surrounding portal veins

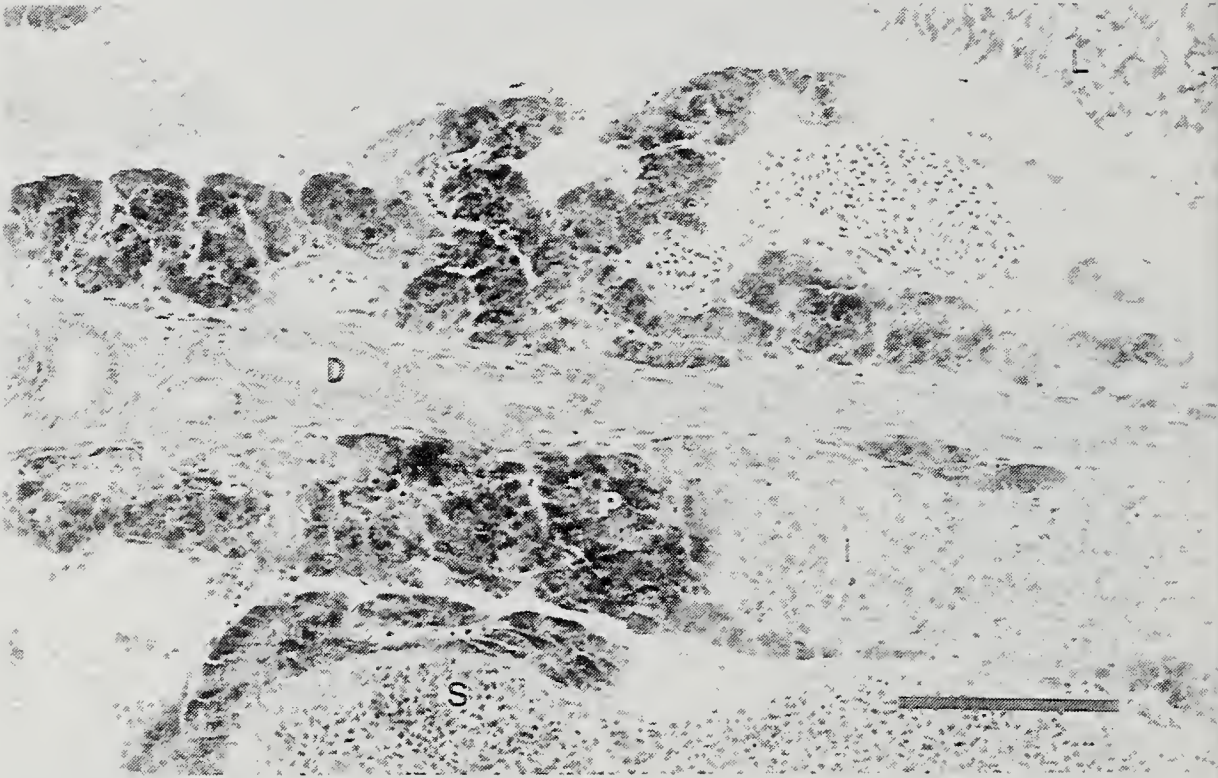


Figure 5. Paraffin section of mangrove rivulus pancreas in the anterior peritoneal cavity. Exocrine pancreas (P), pancreatic islet (I), bile duct (D), liver (L), spleen (S). Hematoxylin and eosin. Bar = 100 μ m.

within the liver. Each pancreatic acinar cell has a basally located, spherical nucleus containing a centrally located, prominent nucleolus. The cytoplasm of these cells is strongly basophilic except for eosinophilic zymogen granules filling the apical portion of the cell. Centro-acinar cells are located adjacent to the lumen or continuous with ductal structures and have clear cytoplasm and a spherical nucleus. The pancreatic ducts consist of cuboidal epithelium surrounded by fibrous tissue. Ultrastructure of mangrove rivulus exocrine pancreas is similar to that of the mummichog, *Fundulus heteroclitus*, another cyprinodontiform species (Vogelbein and Fournie 1994).

The endocrine pancreas in mangrove rivulus consists of a principal islet (Fig. 5) in the anterior peritoneal cavity and smaller islets posterior to the principal islet, but pancreatic islets were not observed in the liver or gall bladder. Exocrine pancreas covers most of the surface of pancreatic islets. Pancreatic islets cells are arranged in lamellae separated by fibrovascular stroma and sinusoids. The pancreatic islets in mangrove rivulus and in other cyprinodontiforms (Klein and Van Noorden 1980) appear similar to those of other fish species.

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HEARSAY CHANGES UNDER THE PROPOSED ALABAMA RULES OF EVIDENCE¹

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INTRODUCTION

The law is ever evolving. It changes to reflect society and technology's continued growth and evolution. While it may be argued that the law changes too slowly, change is inevitable. Evidence law is part of this evolution.

America has entered a new era in evidence law. This new age is marked increasingly by the adoption of comprehensive sets of evidence rules modeled largely after the Federal Rules of Evidence ('Federal Rules') and by a corresponding movement away from the common law of evidence as established by appellate decisions and as supplemented by statutes.²

The Federal Rules of Evidence, which became effective on February 1, 1975, have been adopted in some form by thirty-three (33) states, the military, and Puerto Rico.³ Alabama is currently taking steps to be counted among those states adopting some form of the Federal Rules of Evidence. In 1988, the Alabama Supreme Court appointed an Advisory Committee, comprised of lawyers and judges, to study and submit revised evidentiary rules for the State of Alabama.⁴

The Advisory Committee labored for over four years and in April 1993, the Committee submitted the Proposed Alabama Rules of Evidence, including Advisory Committee Notes, to the Alabama Supreme Court. Later that year, a hearing was held for all interested persons to allow for comments and suggestions on the

¹Manuscript received 2 November 1994; accepted 10 January 1995.

² Gamble and Sandridge, *Around and Through the Thicket of Hearsay: Dispelling Myths, Exposing Imposters and Moving Toward the Federal Rules of Evidence*, 42 Ala. L. Rev. 1:5, 6 (1990).

³ Weinstien and Berger, 5 Weinstien's Evidence T-1 (1989).

⁴ Order of the Supreme Court of Alabama, 615 So. 2d Advance Sheet No. 2, Yellow Insert (1993).

proposed rules.⁵ To date, the Alabama Supreme Court has yet to promulgate the proposed rules, but action is expected in early 1995.

In drafting the Proposed Alabama Rules of Evidence, the Advisory Committee used the format of the Federal Rules of Evidence. The topics of the articles and the numbering system for both sets of rules are all but identical. If the Federal Rules of Evidence reflected existing Alabama law, the federal language was incorporated in toto in the proposed Alabama rules.⁶ Where language and tradition have differed, an effort was made by the committee to follow Alabama law, in recognition that Alabama practice required drafting rule language that was specific to Alabama. In other parts of the rules, the Committee recommended language and practice that differs from existing Alabama law.

Alabama has a rich tradition and history underlying its principles of basic evidence law. The Advisory Committee's proposals have been careful not to disturb the well-reasoned, fundamental principles embodied in Alabama's common law. Of 168 sub-parts contained in the proposed Rules of Evidence, approximately 3/4 continue existing Alabama law.⁷

The intent to preserve existing Alabama law, while furthering the overall goal of admissibility, is reflected in the Introduction to the Proposed Alabama Rules of Evidence. Bob McCurley, Director of the Alabama Law Institute, writes:

In most instances, these rules continue the historic Alabama law of evidence either identically or with slight modification or expansion. Some rules, however, do abrogate preexisting Alabama law. Where change occurs, it generally is to implement the overall policy of promoting greater admissibility. These rules mark a shift from a system of exclusion to one of admissibility.⁸

Admissibility is the primary goal with both the Federal and proposed Alabama Rules of Evidence. Past practice and case law reflected a concern with excluding any evidence which might be construed as suspicious or biased. While these are admirable concerns, the trend is to evaluate the evidence in terms of relevance and

⁵ Id.

⁶ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109 (1993).

⁷ Id.

⁸ Advisory Committee, Proposed Alabama Rules of Evidence, Ala. Law Institute, Introduction, pg. ii (1993).

reliability. The number of exceptions embodied in many rules is indicative of the willingness to allow the trier of fact access to more relevant evidence.

The purpose of this paper is to explore the scope of the proposed rules, including Hearsay Rules, and the changes which will occur with the adoption of the proposed rules.

SCOPE OF THE PROPOSED RULES

The scope of the proposed rules is reflected in proposed Alabama Rules of Evidence 101 and 1011. The intent of the committee is for these rules to apply to all Alabama courts and in adversarial proceedings in which the general law of evidence applied prior to adoption of the proposed rules. As such, the proposed rules will govern: 1) nonjury cases; 2) criminal and civil cases; 3) worker's compensation cases; and 4) proceedings in probate court. It is immaterial whether the trials or hearings are presided over by a judge or magistrate.⁹

The rules will not apply to: 1) Grand jury proceedings, 2) extradition proceedings, 3) preliminary hearings in criminal cases, 4) sentencing hearings or hearings granting/revoking probation, 5) issuance of search warrants, arrest warrants or criminal summonses, or 6) contempt proceedings.¹⁰ These six areas reflect situations or proceedings which Alabama courts have held to be non-adversarial, and therefore, rules of evidence are unnecessary to protect constitutional rights.

HEARSAY

Article VIII begins with Rule 801 which defines the terminology used in the area of Hearsay. Hearsay itself is defined as ". . . a statement, other than one made by the declarant while testifying at trial or hearing, offered in evidence to prove the truth of the matter asserted."¹¹

This definition is consistent with traditional Alabama common law except in one respect. Existing Alabama law does not address the idea of conduct being a form of statement. There is no definitional problem arising with regard to whether assertions in words fall within the ban on hearsay, but the difficulty lies in the treatment of conduct.¹² It is universally recognized that some conduct, such as pointing, nodding in the affirmative or negative, shrugging, and like behavior, is synonymous with a statement or assertion by an individual. It is this conduct which now falls within the definition of hearsay. If the conduct is intended as an assertion,

⁹ Advisory Comm., Prop. Ala. R. Evid. 1011, Comm. Note, Ala. Law Institute (1993).

¹⁰ *Id.*

¹¹ Advisory Comm., Prop. Ala. R. Evid. 801, pg. 217, Ala. L. Institute (1993).

¹² Advisory Comm., Prop. Ala. R. Evid. 801, Advis. Comm. Note, Ala. Law Institute (1993).

it can be defined as hearsay, if it is not, then it will be classified as non-hearsay. The trial court will have the discretion to determine whether the conduct was intended as an assertion,¹³ and the burden of proving that the conduct was intended to be an assertion will lie with the party claiming such assertion as hearsay.¹⁴

Another change in the rules regarding hearsay is the definitional reclassification of previous hearsay exceptions to non-hearsay. Current Alabama law classifies prior inconsistent statement, consistent statements, identification statements or admissions as exceptions to the general hearsay rule. The proposed rule reclassifies them and defines them as non-hearsay.¹⁵ This reclassification is consistent with the overall goal of the proposed Alabama Rules of Evidence in that it allows for greater admissibility and less exclusion of evidence. Once again, the Advisory Committee is attempting to allow more evidence to be presented to the trier of fact. As the Advisory Committee noted, "The indicia of reliability possessed by such statements--the presence of the witness, the ability to cross examine the witness and the nature of the statement--are deemed to overcome the traditional hearsay dangers."¹⁶

The proposed rule 802 actually embodies the general rule regarding hearsay. It is succinct in stating, "Hearsay is not admissible except as provided by these rules, or by other rules prescribed by the Supreme Court or by statute."¹⁷ The proposed rule is consistent with both current Alabama law and the Federal Rules of Evidence.¹⁸

The majority of changes which may occur in the area of Hearsay are in the exceptions embodied in rules 803 and 804. Under these two rules, assertions which fall under the definition of hearsay will not be excluded. The courts have provided for the exceptions due to necessity and a recognition that some types of hearsay are trustworthy. These two rules follow the Federal Rules of Evidence in dividing the exceptions into two parts. Rule 803 involves exceptions where the declarant's unavailability is immaterial, and Rule 804 exceptions only apply if the declarant is unavailable.¹⁹

¹³ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 133 (1993).

¹⁴ Advisory Committee, Prop. Ala. R. Evid. 801, Advis. Comm. Note, Ala. Law Institute (1993).

¹⁵ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 134 (1993).

¹⁶ Advisory Comm., Prop. Ala. R. Evid. 801(d), Advis. Comm. Note, Ala. Law Institute (1993).

¹⁷ Advisory Comm., Prop. Ala. R. Evid. 802, Ala. Law Institute (1993).

¹⁸ Fed. R. Evid. 802, 28 U.S.C. R 802 (1993).

¹⁹ Advis. Comm., Prop. Ala. R. Evid. 803-804, Ala. Law Institute (1993).

Proposed rule 803 encompasses 24 exceptions to the hearsay rule. Most of these 24 exceptions embody existing Alabama law or similar principles.²⁰ Nine of the exceptions contain changes from current Alabama law which are worth noting.

The exception found in subdivision four of proposed rule 803 is the exception of statements made for purposes of medical diagnosis or treatment. Currently only statements made to a physician about past pain and suffering were admitted as an exception to the hearsay rule,²¹ and statements relating to pain can only be admitted if the pain existed at the time of the statement.²² The proposed rule expands this hearsay exception, first by explicitly allowing statements regarding pain and one's physical condition made to individuals other than physicians, thus greatly expanding the admissibility of such relevant medical information. Second, the proposed rule allows for the admissibility of all statements that are made for the purpose of medical diagnosis or treatment and statements as to causation are admissible as well.²³ The subdivision four exception may have broad ramifications in some cases under tort law, including product liability or medical malpractice suits.

The effect of the proposed rule would be a rejection of the current law found in *Southern R. Co. v. Roberts*,²⁴ which held that a physician could not relate statements made during a consultation held solely for the purpose of enabling the physician to testify at trial. Once again, the stated goal of admissibility is being met by allowing the trier of fact access to more relevant evidence.

Subdivision five of the proposed rule 803 addresses the recorded recollection hearsay exception. This exception has traditionally been used when a witness is not able to recall the facts for which he/she has been called to testify. Upon this development, the written record becomes evidence in lieu of the witness' former recollection.²⁵ With the adoption of the proposed rule, the threshold requirements regarding the degree of deterioration in the witness' memory would change. "Pre-rules Alabama law stands for the proposition that a writing is not admissible under Past Recollection Recorded unless the witness manifests 'no present recollection of the matter'."²⁶ The exception embodied in this rule requires that the witness has a

²⁰ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109 (1993).

²¹ *Seaboard System R.R. v. Keen*, 514 So. 2d 1018, 1020 (Ala. 1987).

²² Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 135 (1993).

²³ Advis. Comm., Prop. Ala. R. Evid. 803(4), Advis. Comm. Note, Ala. Law Institute (1993).

²⁴ *Southern R. Co. v. Roberts*, 380 So. 2d 774 (Ala. 1980).

²⁵ *Worsham v. Fletcher*, 454 So. 2d 946 (Ala. 1984).

²⁶ Advis. Comm., Prop. Ala. R. Evid. 803(5), Advis. Comm. Note, Ala. Law Institute (1993).

lack of sufficient recollection to enable that witness to testify accurately.²⁷ In other words, the threshold requirement for conditions precedent to the use of this exception have been liberalized, once again reflecting the goal of admissibility.

The Advisory Committee warns, however, that the exception should be used cautiously so as to eliminate the possible misuse which might arise if a witness were to "feign insufficient recollection in order to get before the jury a written statement of the witness' testimony that has been carefully prepared for purpose of the litigation."²⁸

The exception found in proposed rule 803(6) expands the common law version of the Business Records Exception. The proposed rule would supersede two existing Alabama laws: The Alabama Business Records exception to hearsay in civil cases²⁹ and the Business Records Exception for criminal cases found in the Alabama statutes.³⁰

The proposed rule is based on reliability and necessity. As many businesses are required to keep records in the course of regularly conducted business, it is logical that such records would be reliable. The party seeking to introduce such business records into evidence must be able to show that the business has a regularly used method of keeping records in order to qualify. The largest change in this proposed rule is the expansion of the definition of business. Under the new rule, business would include any business institution, association, profession, occupation or calling of every kind without regard to whether it is conducted for profit.³¹ Current Alabama law does not recognize non-profit organizations as businesses.

Public records are another topic addressed under the hearsay exceptions found in proposed rule 803. Current Alabama law does not allow for the admission of public records which contain the opinions of the individual doing the report or investigation.³² In *Rainy v. Beech Aircraft*³³ the U.S. Supreme Court held that reports containing opinions were admissible even though they contain opinions, as long as the opinion is based on an official investigation. This ended the confusion of previous lower court case law.

²⁷ Id.

²⁸ Id.

²⁹ Ala. R. Civ. P. 44(h), Code of Alabama (1993).

³⁰ Alabama Business Records Exception, Code of Alabama § 12-21-43 (1975).

³¹ Advis. Comm., Prop. Ala. R. Evid. 803(6), Advis. Comm. Note, Ala. Law Institute (1993).

³² Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 136 (1993).

³³ *Rainy v. Beech Aircraft*, 488 U.S. 153, 109 S. Ct. 450, 102 L. Ed. 2d 457 (1988).

The Federal Rule of Evidence and the proposed Alabama rule follows the holding of *Rainy* in that "Rule 803(8)(c) adopts a broader view, which renders admissible factual findings resulting from investigations made pursuant to authority granted by law, unless the sources of information or other circumstances indicate a lack of trustworthiness."³⁴ The Advisory Committee does note that this rule does not apply against the accused in criminal cases.³⁵

Records of religious organizations, under current Alabama law, are an exception under the business records exception to the hearsay rule. The proposed rule 803(11) recognizes a specialized exception for religious records. The proposed rule would supersede Alabama Code §12-21-101, 30-1-7(b) (1975).³⁶

The proposed rule 803(13) regarding family records will broaden the scope of common law. Current law only recognizes statements regarding family history contained in family Bibles and inscriptions on tombstones. The new rule would include genealogies, charts, engravings on rings, inscriptions on family portraits, engravings on urns, crypts, and the like.³⁷

Another hearsay exception changing with the promulgation of the proposed evidence rules is the Learned Treatise exception found in rule 803(18). Unlike most states, Alabama currently permits a learned treatise to be admitted as direct evidence in a case, rather than limiting its use to cross examination of experts.³⁸ This would change with the proposed rule. "Rule 803(18) permits such materials if the learned treatise is established as reliable authority by expert testimony or judicial notice. However, contrary to existing law, the material may be read into evidence, but not received as an exhibit."³⁹

In other words, the proposed rule, while allowing for admissibility, sets some conditions precedent and will not allow for the treatise to become an exhibit for examination by the trier of fact. This allows for safeguards which previously did not exist in Alabama law.

The first of the safeguards are the conditions precedent. With the proposed rule the treatise, periodical or pamphlet must be established as a reliable authority,

³⁴ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 136 (1993).

³⁵ Advis. Comm., Prop. Ala. R. Evid. 803(8)(c), Advis. Comm. Note, Ala. Law Institute (1993).

³⁶ Advis. Comm., Prop. Ala. R. Evid. 803(11), Advis. Comm. Note, Ala. Law Institute (1993).

³⁷ Advis. Comm., Prop. Ala. R. Evid. 803(13), Advis. Comm. Note, Ala. Law Institute (1993).

³⁸ *Seaboard Systems R.R. v. Page*, 485 So. 2d 326 (Ala. 1986).

³⁹ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 136 (1993).

(i.e., the author is recognized in his/her field of endeavor and there must be professional acknowledgement of the accuracy of the publication), and the party offering the publication must show 1) the publication was relied upon by an expert during direct examination, or 2) the publication was called to the expert's attention on cross-examination.⁴⁰ By requiring both of these, the proposed rule insures admissibility while allowing the trier of fact to hear evidence supported by a true expert in the field.

The second safeguard is the reading of the learned treatise into the record, rather than allowing it as an exhibit. When learned treatises are allowed as exhibits, there is a danger that the trier of fact will use that treatise as a "bible" upon deliberation and give it more evidentiary weight than it deserves. By reading the information contained in the learned treatise into the record, it is assured that the trier of fact has the information relevant and necessary for rendering a decision, while assuring that the information is not being used beyond the scope of its evidentiary usefulness.⁴¹

Proposed Rule 803(22) addresses the hearsay exception of previous convictions. Current law, found in *Durham v. Tarabee*,⁴² allowed for the admission of a misdemeanor or felony conviction as an exception to the hearsay rule. In the proposed rule, only felony convictions will be admitted as an exception to the rule. The reason for this change lies in the reality that a defendant is generally not as motivated to defend against misdemeanor charges and often defaults or plea bargains, and one should not have further negative consequences as a result.⁴³ Further, only convictions based on trial or guilty plea may be used and even convictions pending appeal are admissible as an exception to hearsay. This is a change from current Alabama law which excluded a conviction being appealed.⁴⁴

The last subsection found in proposed rule 803 is entitled Other Exceptions. While it is not unusual for court rules to contain "catch-all" provisions, this subsection provides one for the Alabama Hearsay rule for the first time. As noted, "A 'catch all' clause is provided for the purpose of 'promot[ing] growth and development' in the law of hearsay."⁴⁵ Under this exception, courts are given some latitude and

⁴⁰ Advis. Comm., Prop. Ala. R. Evid. 803(18), Advis. Comm. Note, Ala. Law Institute (1993).

⁴¹ Id.

⁴² *Durham v. Tarabee*, 481 So. 2d 885 (Ala. 1985).

⁴³ Advis. Comm., Prop. Ala. R. Evid. 803(22), Advis. Comm. Note, Ala. Law Institute (1993).

⁴⁴ Id.

⁴⁵ Advis. Comm., Prop. Ala. R. Evid. 803(26), Advis. Comm. Note, Ala. Law Institute (1993).

discretion to admit hearsay which does not fall under one of the enumerated exceptions. "It is intended that this exception . . . will be used very rarely."⁴⁶

Proposed rule 804 deals with exceptions to the hearsay rule when the declarant is unavailable. The first changes made by this proposed rule are changes and expansions in the definition of unavailable. With the new rule, the definition includes a witness' refusal to testify in spite of a court order and also the witness' lack of memory of the subject.⁴⁷ Neither of these aspects of unavailability are part of current Alabama law. Once again, the proposed rule is designed to be more inclusive when questions of admissibility arise.

The admissibility of former testimony is at issue in proposed rule 804(b)(1). Current Alabama law allows for the admission of former testimony from prior hearing against the same party for whom it was formerly offered. The proposed rule would admit such testimony even when offered against the party who originally testified or offered it.⁴⁸ In other words, the offering of former testimony now can act as a two-edged sword, cutting both the offeror and the offeree. Alabama law, both current and proposed, does require substantial identity of issues between the former and present actions. The test to be used is whether the party against whom testimony is now offered (or the party predecessor) had an opportunity and similar motive to develop the declarant's testimony through cross examination, direct examination, or redirect examination.⁴⁹ If the issue discussed at the former hearing is not substantially the same as the issue at the present hearing, the fear is that one or both of the parties may not have involved themselves in as intensive questioning on cross, direct or redirect examination. If this were so, the trial court would be obligated to declare such testimony hearsay which would not fall under this exception.

The last topic to be addressed from proposed rule 804 is the dying declaration exception. Current Alabama law follows the holding found in *Thompson Tractor Co. v. Cobb*,⁵⁰ which says Alabama law limits application of this exception [dying declaration] to criminal cases where death of declarant served as the basis of the prosecution. To meet this standard, the prosecution would have to be for some degree of murder, manslaughter, negligent homicide or the like. The proposed rule would apply this hearsay exception to all civil and criminal cases and in situations where the declarant did not ultimately die. It would have to be shown that the

⁴⁶ Id.

⁴⁷ Cusimano and Roberts, Proposed Alabama Rules of Evidence: What's the Same? What's Different?, 45 Ala. L. Rev. 1:109, 137 (1993).

⁴⁸ Id.

⁴⁹ Id.

⁵⁰ *Thompson Tractor Co. v. Cobb*, 214 So. 2d 558, 564 (Ala. 1968).

declarant believed that death was certain and imminent for the exception under the proposed rule to apply.⁵¹

Unlike the Federal Rules of Evidence, the proposed Alabama Rules of Evidence include a hearsay exception for children. This exception, based on The Child Abuse Victim Protection Act of 1989, Alabama Code §15-25-31, -32, is embodied in proposed rule 807. This specialized rule is applicable to statements made by children under 12 years of age in sexual abuse prosecutions.⁵² Proposed rule 807 follows the code, and Alabama law in this area would remain unchanged with the adoption of this rule. "Rule 807 is of such breadth as to permit the admission of all child hearsay statements that heretofore could have gained admissibility under pre-rules state application only in dependency hearings."⁵³ Proposed rule 807, like the Alabama statute noted above, could not be used in other adversarial proceedings.

CONCLUSION

The proposed Alabama Rules of Evidence will bring the State of Alabama in line with the federal rules and court system, as well as those of other states. While many practitioners may be apprehensive about the proposed changes, the above discussion should lend some comfort. In many instances, the proposed hearsay rules have retained the basic tenor of current Alabama law, and where changes occur, they have been made for compelling and legitimate purposes. Without the evolutionary nature of these rules, no progress can be made. The Proposed Alabama Rules of Evidence, and specifically the proposed Hearsay Rules, mark a step up on the evolutionary ladder in Alabama legal history.

⁵¹ Advis. Comm., Prop. Ala. R. Evid. 804(b)(2), Advis. Comm. Note, Ala. Law Institute (1993).

⁵² Code of Alabama §15-25-31, -32 (1975).

⁵³ Advis. Comm., Prop. Ala. R. Evid. 807, Advis. Comm. Note, Ala. Law Institute (1993).

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THE EFFECTS OF VARYING SALINITIES ON POLYAMINE LEVELS
AND THEIR RELATION TO Na^+ K^+ ATPASE DURING
EARLY DEVELOPMENT IN THE BRINE SHRIMP
ARTEMLA FRANCISCANA

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ABSTRACT

Polyamine levels were measured in pre-naupliar and early stage I larvae of *A. franciscana* reared at various salinities ranging from 5 to 50 ppt. Polyamine levels increased significantly during pre-naupliar development and showed the same developmental pattern of increase as Na^+ K^+ ATPase specific activity. The levels of putrescine and the ratio of put/spd + sp were highest at low salinities; spermidine and spermine were not influenced by salinity exposure. Conversely, Na^+ K^+ ATPase specific activity is not affected by salinity exposure. Increases in polyamine levels and Na^+ K^+ ATPase specific activity during pre-naupliar development, regardless of salinity, may associated with developmentally related functions. However, differential putrescine production in response to varying salinities may be related to the kinetic regulation of Na^+ K^+ ATPase activity, allowing adjustments in ionic and osmotic homeostasis of the organism.

INTRODUCTION

The polyamines spermine and spermidine and their diamine precursor putrescine are low molecular weight organic cations that influence various metabolic processes in mammalian cells and tissues. Polyamines are essential for normal cell growth and proliferation in both eukaryotic and prokaryotic cells (reviewed by 1-4). In addition, studies have also suggested that polyamines may be important molecules in the regulation of osmotic homeostasis; alterations in polyamine levels (particularly putrescine) occur in mammalian cells (5-12), plant cells (13-20), and bacteria (21-23) following changes in the external osmolarity. Despite the widespread responses of the polyamines to osmotic stress in different organisms, the specific functional relevance of these responses is not clear.

The potential involvement of polyamines in osmotic and ionic control in aquatic invertebrates has not been extensively investigated. Studies with mammalian cells have shown that ornithine decarboxylase (ODC, the rate limiting enzyme in

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polyamine production) activity changes in response to alterations in salinity (5-7). It has been previously shown in the brine shrimp *A. franciscana* that ODC is synthesized *de novo* within minutes of hypoosmotic stress (24), and that new synthesis is immediately halted during hyperosmotic stress (25). In the blue crab, *Callinectes sapidus*, levels of putrescine increased in the gills following a two week exposure to hyperosmotic conditions (26). These data suggest that levels of ODC and polyamines (particularly putrescine) are altered in response to osmotic stress and that these responses enable the organism to cope with changes in salinity.

In various vertebrate organisms and tissues, polyamines are known to influence the activity of the ion transporting enzyme $\text{Na}^+ \text{K}^+ \text{ATPase}$. $\text{Na}^+ \text{K}^+ \text{ATPase}$ has a crucial role in regulating ionic and osmotic homeostasis in many aquatic organisms (27-29). The effects of the polyamines on $\text{Na}^+ \text{K}^+ \text{ATPase}$ varied depending on cell type, ion concentrations, and ATP concentration (30-37). Despite the differences in response, all these studies suggest polyamines influence, or are related somehow, to $\text{Na}^+ \text{K}^+ \text{ATPase}$ activity.

Holliday et al. (38) have postulated that modulation of $\text{Na}^+ \text{K}^+ \text{ATPase}$ activity, most probably by some allosteric modulatory molecule(s), is a mechanism by which *Artemia* respond to short-term changes in salinities. For example, during larval development, the pattern and levels of $\text{Na}^+ \text{K}^+ \text{ATPase}$ specific activity are similar among animals exposed to a range of salinities (5 to 50 ppt) (39). We hypothesize that modulation of existing enzyme activity is important during this period of development. Based on the previously mentioned studies, a possible mechanism by which short-term regulation of $\text{Na}^+ \text{K}^+ \text{ATPase}$ could occur may involve the production of polyamines. We have measured levels of polyamines in prenaupliar and early stage I *A. franciscana* larvae reared at various salinities to determine if polyamine levels could be correlated to salinity exposure and to $\text{Na}^+ \text{K}^+ \text{ATPase}$ activity during this period of development

MATERIALS AND METHODS

Animals

Brine shrimp obtained in cyst form (San Francisco Bay Brand, Lot #1879) were hydrated in distilled water at 4°C overnight. Cysts floating on top were discarded. In all experiments viable cysts were incubated at 27°C in artificial seawater (Tropic Marin) under constant light and aeration. Cysts were incubated in sixteen 61 containers of either 5, 12, 32, or 50 ppt salinity (four containers per salinity). *Artemia* is hypoosmotic to seawater above ca.9 ppt and hyperosmotic to seawater below 9 ppt (40). A pooled sample of animals (approximately 0.5-1 g wet wt) was removed from each of the containers at 15, 18, 22, 26, 30, 34, and 38 hr after the start of incubation. The first two samples (at 15 and 18 hr) were obtained by

removing aliquots of water containing cysts, E1, E2, and naupliar stages. All subsequent samples were obtained by selectively removing only hatched nauplii. Samples were filtered by vacuum filtration, rinsed quickly with ice cold ddH₂O to remove excess salts and stored at -20°C until analysis. In addition, a small sample of animals were preserved in 70% ethanol for determination of the various developmental stages present at the time of sampling. The stages were identified visually using a dissecting microscope. Percent water was calculated by drying two samples of animals at 60°C for 48 hr.

Polyamine Analysis

Extraction and derivitization of polyamines were performed following the protocol of Watts et al. (41). Briefly, tissue samples were homogenized in ddH₂O (1:4 w:v) and then sonicated to completely disrupt cell and nuclear membranes. After sonication, perchloric acid (final concentration 0.45 N) was added to the homogenate and extraction proceeded for 30 min at 0°C. The homogenate was then centrifuged at 1250 g for 20 min and the supernatant containing the extracted polyamines was removed and stored at -20°C until derivitization.

Sample supernatants and standards (200ul) were added to screw top tubes containing 40 mg of sodium bicarbonate and reacted with dansyl chloride (400 ul of a 20 mg/ml solution in acetone) at 60°C for 1 hr in the dark. Proline (100 ul of a 200 mg/ml solution) was then added and allowed to react for 1 hr at 60°C (binds excess dansyl chloride). Excess acetone was removed by evaporation under air. Toluene was then added (to extract dansyl amines) and tubes centrifuged at 1000g for 10 min. The upper, toluene layer containing the polyamines was removed and transferred to a separate test tube. This step was repeated once and the toluene layers were combined and evaporated under air. Precipitated dansyl amines were then resuspended in methanol and filtered with Gelman Acro LC35 0.45 micron filters in preparation for HPLC.

HPLC was performed using a Perkin Elmer Series 410 Bio LC Pump with a gradient solvent system of acetonitrile and heptane sulfonic acid (5mM, pH 3.5/triethylamine 0.1%). Polyamines were separated on a 3 cm, reverse-phase C₁₈ column with a 5 um pore size and detected with a Shimadzu RF 535 fluorescence detector. Levels were expressed at umol/g tissue.

Statistics

Multiple comparisons of polyamine values among the four salinities at each sampling time were performed using an ANOVA and Fisher LSD test.

RESULTS

Development of shrimp reared at 50 and 32 ppt was delayed compared to those growing at 12 and 5 ppt, i.e., there was a greater percentage of animals at prenaupliar stages of development and fewer at the naupliar stage of development at the higher salinities. At 15 hrs, the 50 ppt culture consisted of approximately 11% free swimming nauplii while at 5 ppt, almost 36% of the embryos had hatched (fig. 1A). By 18 hrs those percentages had shifted to 36 and 53%, respectively (fig. 1B). However, the final percent emergence was not altered by salinity: approximately 65% of the embryos had emerged from their cysts by 18 hr regardless of the salinity (fig. 1B). At subsequent sampling times only free swimming nauplii were collected for determination of polyamine content.

The effects of different external salinities on levels of polyamines during early development are shown in figures 2, 3, and 4. Putrescine concentrations were highest, followed by spermidine and spermine. Shrimp reared in all four salinities exhibited similar patterns of polyamine production. Putrescine levels increased significantly from 15 hr to a maximum at ca. 26-30 hr and then remained high or decreased slightly (fig. 2). Putrescine levels were also highest in animals grown at 5 ppt through most of stage I development. Levels of spermidine and spermine were not correlated to salinity, however, these polyamines increased in levels throughout emergence and stage I development (figs. 3 & 4).

The ratio of putrescine to spermidine plus spermine (put/spd + sp) was also calculated to examine the relative changes in putrescine levels with respect to the other polyamines. In shrimp reared in any of the four salinities, this ratio remained relatively constant during emergence and early stage I. During late stage I the ratios steadily declined (fig. 5) regardless of salinity. Throughout stage I development, the ratio of put/spd+sp was highest in shrimp reared in 5 ppt and was lowest in shrimp reared in 32 and 50 ppt.

DISCUSSION

During the early development of *A. franciscana*, putrescine levels were inversely related to salinity; at low salinities the levels of putrescine and the ratio of put/spd+sp were the highest. These results are in agreement with previous studies examining polyamine levels in response to osmotic stress; putrescine was the principal polyamine affected by changes in osmolarity. In mammalian cells, Poulin and Pegg (11) observed hypoosmotic stress accompanied by a dramatic accumulation of putrescine, with little to no changes in spermidine or spermine. Poulin et al. (12) assessed the possible adaptive function of an increased production of putrescine and suggested a role for putrescine in growth adaptation to lower osmolarity. In bacterial cells, Munro et al. (21) postulated that excretion of putrescine following an increase in medium osmolarity could be used by the cell to balance an increase in internal

positive charges resulting from K^+ uptake. Peter et al. (22) suggested that increased polyamine concentrations may result in a stabilization of the cellular membrane and a reduction in passive permeability. Other studies (5,7,23) were unclear on the significance of increased putrescine levels and generally stated that they thought that it was a mechanism whereby cells could restore intracellular ionic balance.

In all of these studies, changes in polyamine content are apparently part of the cellular response to changes in salinity. Whether these changes in polyamine content are a consequence of the change in salinity, or a compensatory strategy for acclimating to salinity change is not known. We hypothesize that polyamine metabolism is a necessary component of cellular responses during osmotic and ionic stress and previous reports suggest that a mechanism by which polyamines allow the organism to adjust to the external environment could be through specific interaction with the enzyme $Na^+ K^+ ATPase$.

In the brine shrimp *Artemia*, the activity of $Na^+ K^+ ATPase$ is first detected in the early pre-naupliar stage (E1), increases through the late prenaupliar stage (E2), and continues to increase to high levels in stage I nauplii (42). Interestingly, polyamine production also followed this same pattern; low levels during the E1 stage, increasing during the E2 stage to high levels in stage I nauplii. In hyporegulating organisms such as *Artemia*, where the hemolymph ion concentration is usually maintained well below that of the external medium, it might be expected that higher $Na^+ K^+ ATPase$ activity would be needed at the higher salinities to accommodate the increased rate of ion transport. However, the developmental pattern of $Na^+ K^+ ATPase$ enzymes synthesis is apparently not influenced by the salinity of the external medium; there was no significant difference in the pattern or levels of enzyme activity in *A. franciscana* embryos and stage I nauplii exposed to various salinities (see Fig. 6). Conversely, there is differential polyamine production by stage I; putrescine is significantly higher in animals exposed to low salinity.

Why do polyamines show the same pattern of production as $Na^+ K^+ ATPase$ during early development? Polyamine levels may be increasing in the organisms as a normal response to developmentally related functions. However, by stage I, the elevated levels of putrescine in animals exposed to low salinity could be related to regulation of $Na^+ K^+ ATPase$. Lee (43) suggested that polyamines can inhibit *A. franciscana* $Na^+ K^+ ATPase$ specific activity *in vitro*. The exact mechanism of inhibition is not known. Preliminary studies (unpublished data) indicate that polyamines may dramatically reduce $Na^+ K^+ ATPase$ activity at physiological ion levels. Similarly, there is evidence that the K_m of $Na^+ K^+ ATPase$ for Na^+ is altered by polyamines in mammalian cells (31-32, 37). These data suggest that polyamines may influence $Na^+ K^+ ATPase$ *in vivo* by influencing the kinetics of ion binding, i.e., polyamines may serve as allosteric effectors of $Na^+ K^+ ATPase$.

In addition to serving as direct allosteric effectors of $Na^+ K^+ ATPase$ activity *in vivo*, polyamines may act as either short or long-term regulators of ion transport

indirectly via changes in the synthesis or insertion of transport proteins. Protein synthesis may be a candidate for a site of action for the polyamines; protein synthesis is known to be sensitive to changes in K^+/Na^+ ratios and is regulated by putrescine, spermidine, and spermine (12). The role of polyamines in the synthesis/assembly of $Na^+ K^+$ ATPase has not been investigated. Additionally, polyamines may influence other ion transporters and enzymes such as Na^+/H^+ , K^+/H^+ and carbonic anhydrase.

In summary, putrescine is the principal polyamine which accumulates in developing nauplii which have been exposed to reduced salinities. Differential polyamine production in response to varying salinities may allow the organism to adjust to the external environment, perhaps specifically via regulation of $Na^+ K^+$ ATPase. We hypothesize that polyamines may alter the kinetic parameters of $Na^+ K^+$ ATPase resulting in differential ion transport during ionic and osmotic regulation. Consequently, information on Na^+ flux in *A. franciscana* nauplii is essential for a full understanding of the interactive effects of the polyamines on $Na^+ K^+$ ATPase. The role of the polyamines as molecules involved in the regulation of $Na^+ K^+$ ATPase in organisms exposed to ionic and osmotic stress deserves further investigation.

Brine Shrimp

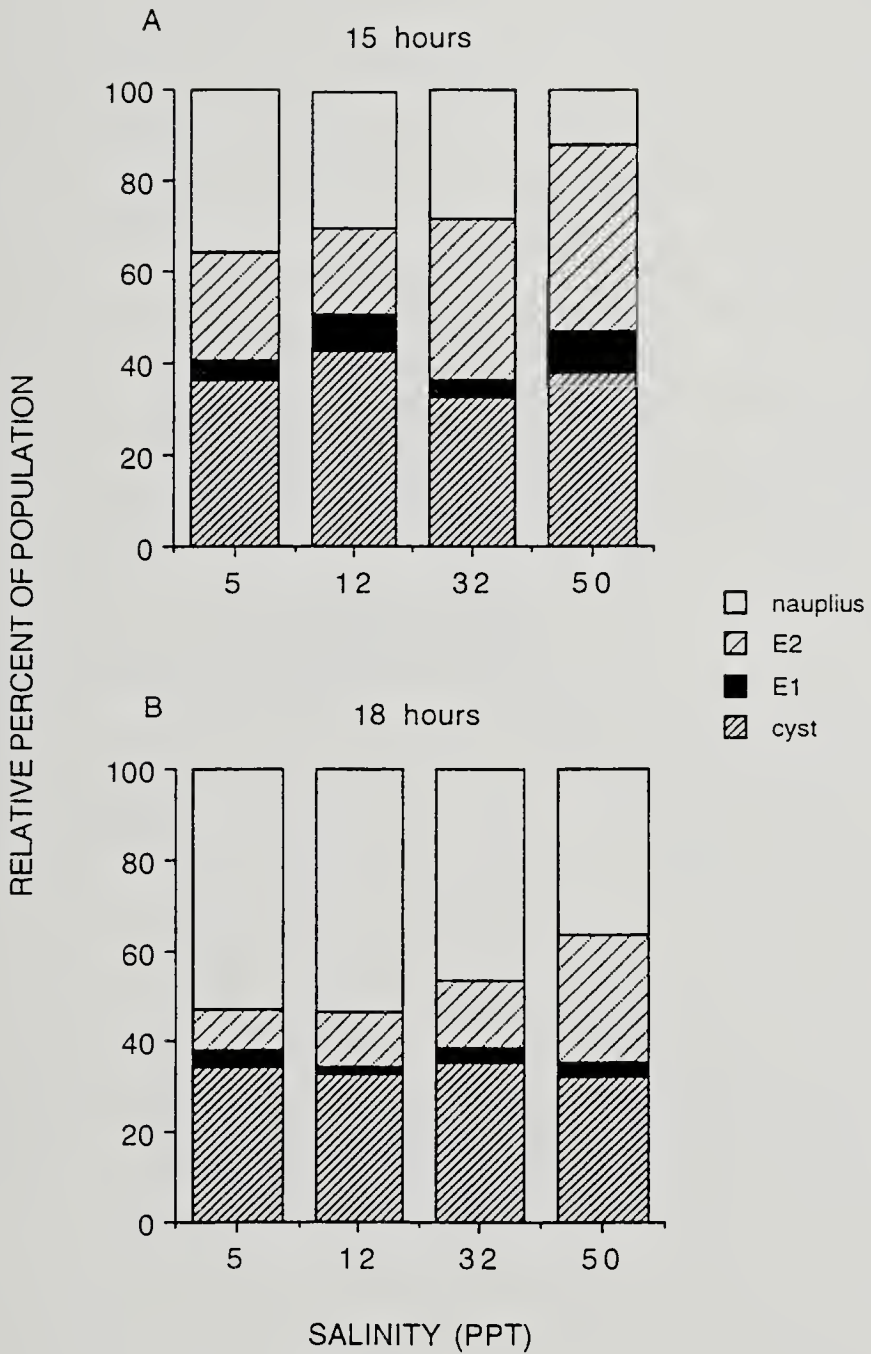


Fig. 1. Relative proportions of early developmental stages of *Artemia* at 15 (A) and 18 (B) hours after incubation of cysts in four different salinities. Four to five subsamples (ca.200-300 individuals/subsample) were counted and averaged at each salinity

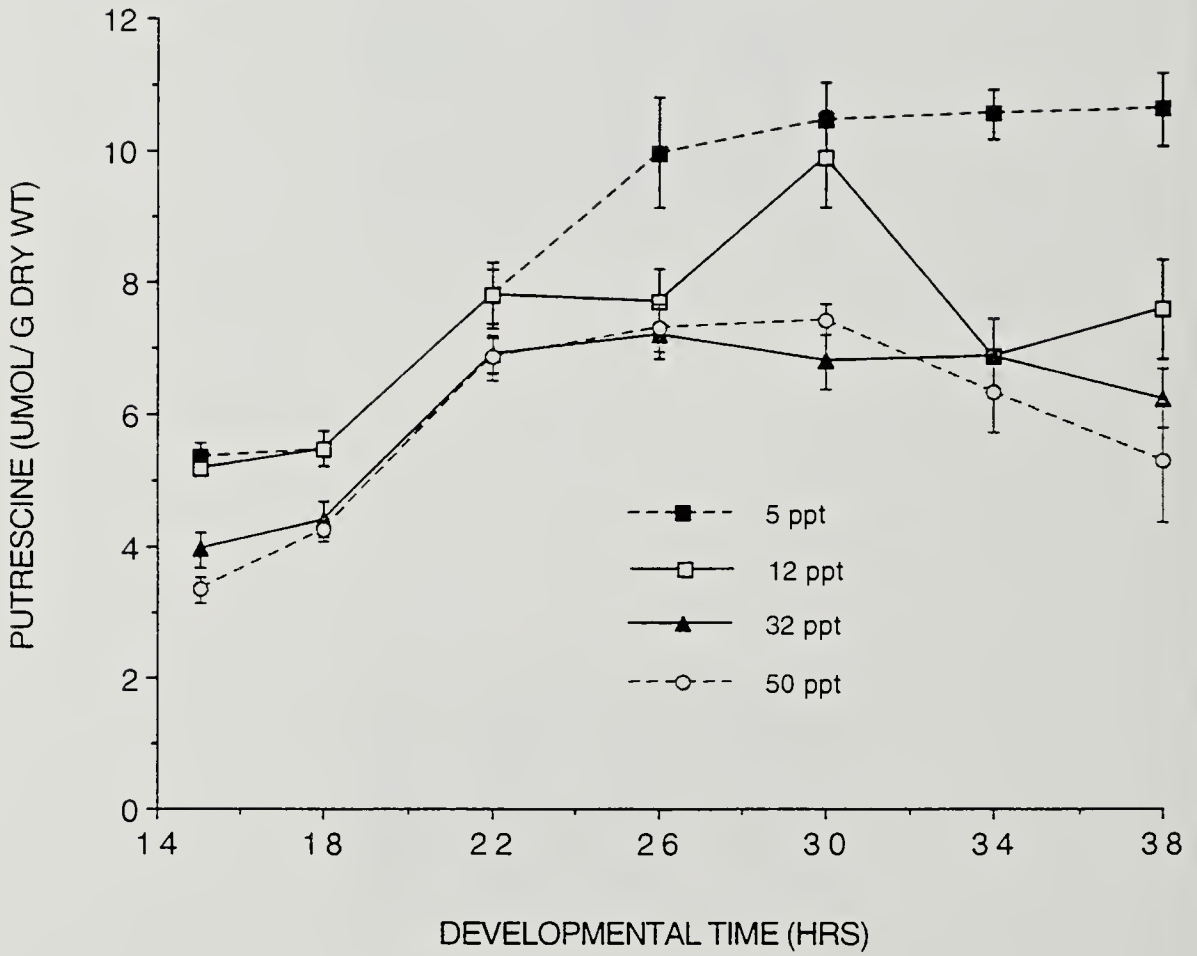


Fig. 2. Levels of putrescine during early development of brine shrimp cultured at various salinities. Levels are expressed as a function of dry weight. Points represent mean values $\pm$ S.E. (n=3-4 replicates, each from a pooled sample of brine shrimp).

Brine Shrimp

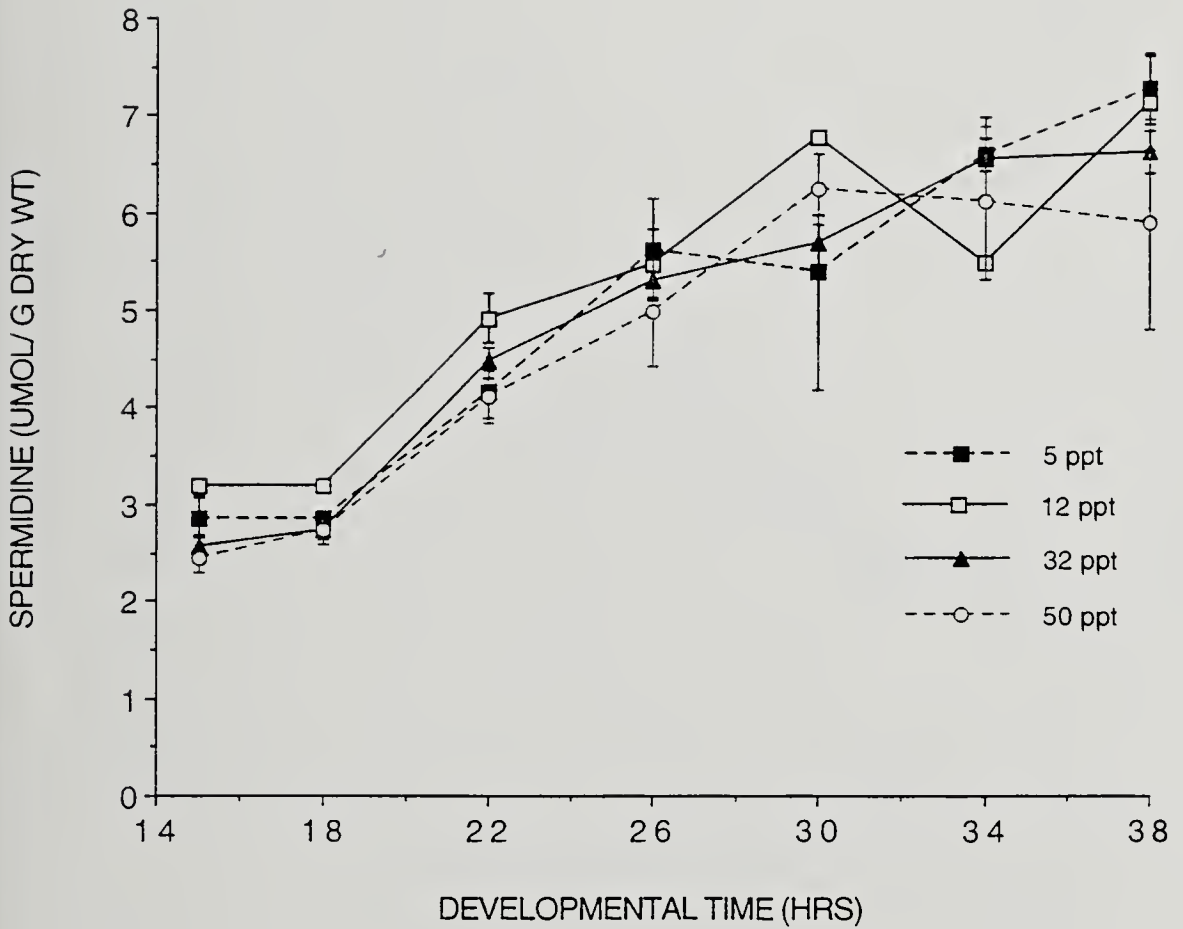


Fig. 3. Levels of spermidine during early development of brine shrimp cultured at various salinities. Levels are expressed as a function of dry weight. Points represent mean values $\pm$ S.E. ($n=3-4$ replicates, each from a pooled sample of brine shrimp).

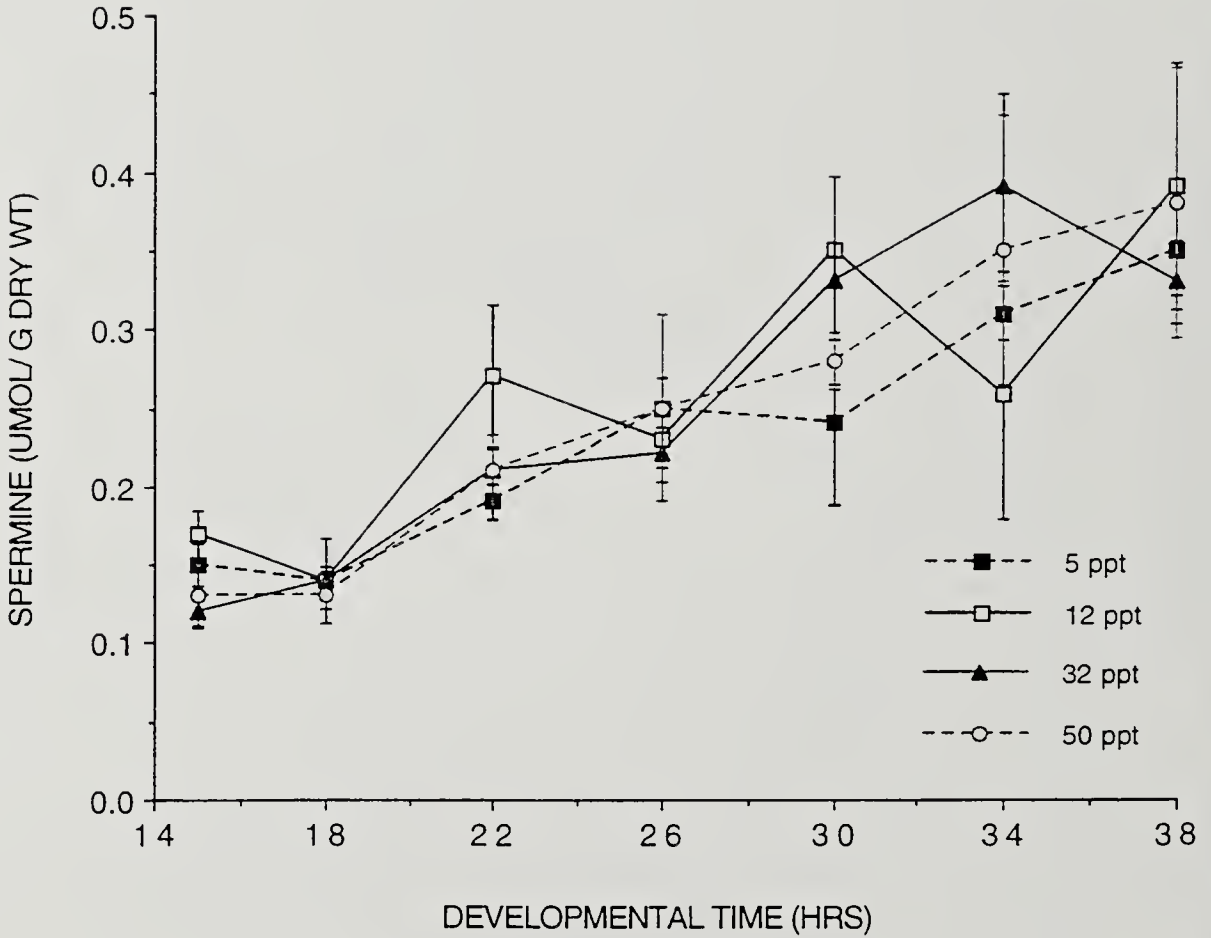


Fig. 4. Levels of spermine during early development of brine shrimp cultured at various salinities. Levels are expressed as a function of dry weight. Points represent mean values $\pm$ S.E. (n=3-4 replicates, each from a pooled sample of brine shrimp).

Brine Shrimp

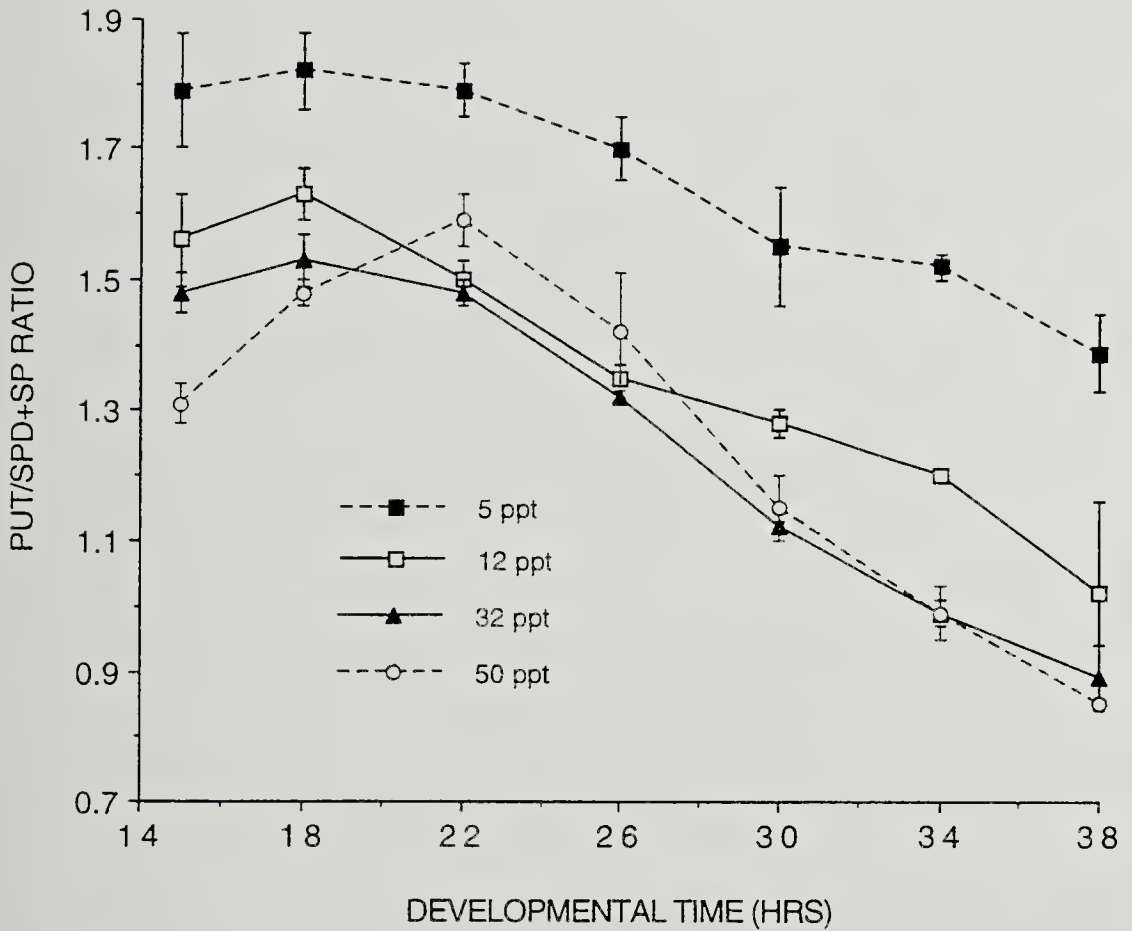


Fig. 5. Ratio of putrescine to spermidine plus spermine levels during early development of brine shrimp cultured at various salinities. Points represent mean values $\pm$ S.E. (n=3-4 replicates, each from a pooled sample of brine shrimp).

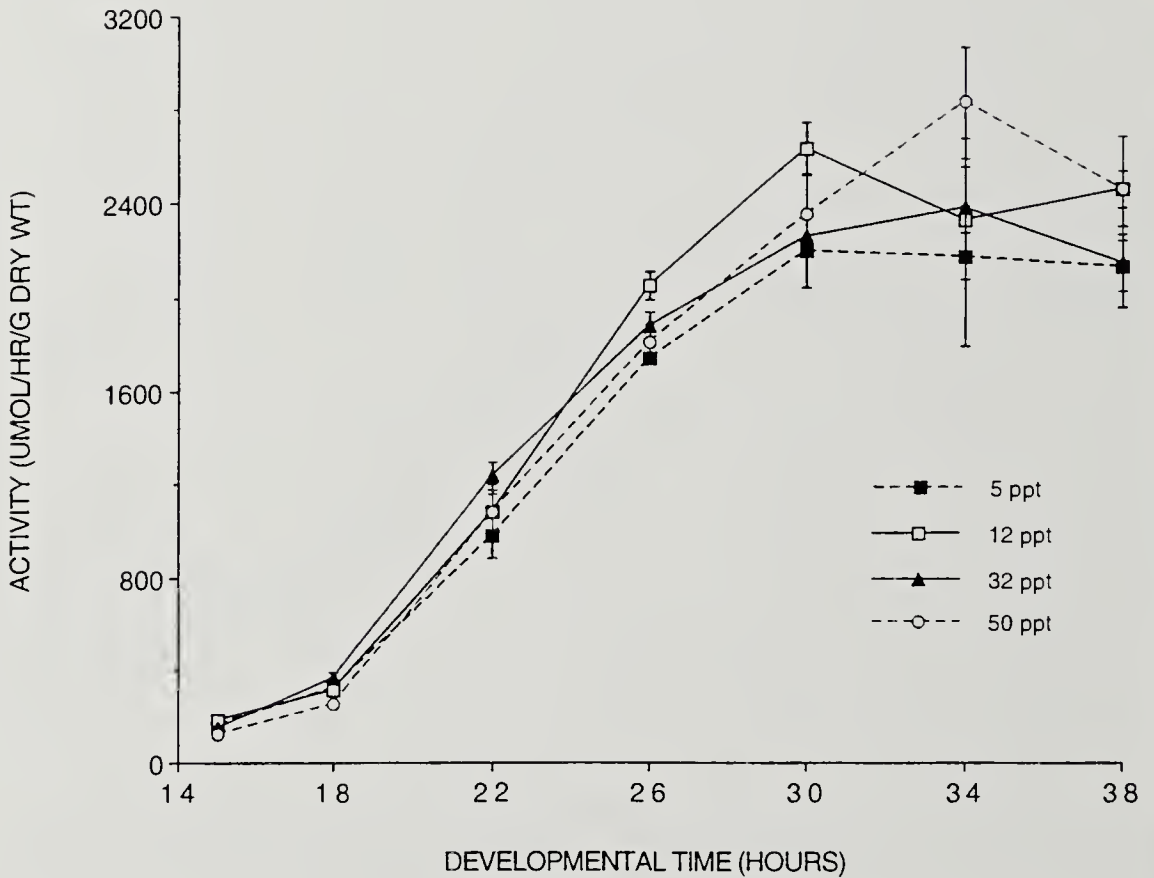


Fig. 6. The specific activity of $\text{Na}^+ \text{K}^+$ ATPase during early development of brine shrimp cultured at various salinities. Enzyme activity was measured in groups of embryos and/or nauplii harvested at times ranging from 15 h to 38 h after the start of incubation. Activity is expressed as a function of dry weight. Points represent mean values + SE ($n=3-4$ replicates, each from a pooled sample of brine shrimp). Reprint from Lee and Watts (Physiol. Zool. 67(4): 910-924).

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SURVEY OF COMPUTERIZED ACCOUNTING INFORMATION SYSTEMS¹

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INTRODUCTION

Clearly, computer use in many businesses has risen dramatically in the last few years. With falling prices of both hardware and software, and the easy-to-use prepackaged software now available, it is easy to understand why so many businesses, even very small one-owner businesses, are choosing to computerize their operations.

Though a few studies have provided some light on the extent of software usage in the accounting field, none have dealt with the usage of accounting software in the manufacturing sector. No study has related the use of accounting software to the various types of computer hardware.

To obtain insight into the use of computerized accounting information systems (CAIS), a survey of local manufacturers in northwest Alabama was conducted. The survey's central purpose was to identify the extent of use of computerized accounting information systems. An auxiliary purpose was to investigate the types of hardware and software being used with the CAIS systems. Surprisingly, there were a greater number of companies not using computerized accounting systems than there were companies that were using computerized systems.

A random sample of 120 companies was drawn from a listing compiled and distributed by the Chamber of Commerce of the Shoals entitled **Shoals Area Manufacturers**. A telephone survey was used to identify which of those companies

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used a computerized accounting information system in house. Of the 120 companies surveyed, 70 (58.3%) did not use a computerized accounting information system, and 50 (41.7%) did use a computerized accounting information system. The 50 companies using computerized systems were then asked questions on the telephone concerning (1) general company information, (2) type of hardware used, (3) type of software used, and (4) number of accountants employed.

For each of the 113 accountants working at the 50 companies where computerized systems were in use, a written questionnaire was mailed to capture further details on the users of the computerized systems. Of the 113 questionnaires mailed, 65 were returned, resulting in a 57.5% response rate.

RESULTS OF THE SURVEY

Of the 50 companies surveyed by telephone that were using computerized systems, most were small manufacturers with an average number of employees of 221. The average number of employees using the computerized accounting information system was four.

The type of hardware in use included mainframe computers, minicomputers, and microcomputers, both standalone and networked. As shown in Table 1, three companies used a mainframe system with an average of 28 terminals. Eighteen companies used a minicomputer with an average of ten terminals. Thirty-seven of the companies used microcomputers (eight of these have micros and minis) with an average of three standalone micros and ten networked micros.

Table 1

Type of Hardware Used with CAIS Systems

Type of Hardware In Use	Number of Companies Using	Average Number of Terminals	
Mainframe	3	28	
Minicomputers	18	10	
Microcomputers	37	Standalone Average	Networked Average
		3	10

Computerized Accounting Information Systems

Of the 50 companies with computerized systems, only 16% were accessible via modem. Hardware failure was infrequently or never experienced by 94% of the companies. Provisions for hardware backup were in place for only 44% of the companies.

The type of software used in the computerized accounting information systems was varied. It appears that firms with mainframes or microcomputers are more likely to use prepackaged software and those with minicomputers are more likely to develop their accounting software in-house, as can be seen in Table 2.

Table 2

Type of CAIS Software Used on Different Computer Systems

Type of Hardware Used	Type of Software Used			
	Number Using Prepackaged	Number Using In-House	Number Using Custom	Number Using Combined
Mainframe	3			
Minicomputers	5	9		4
Microcomputers	21	1	3	4
Total	29	10	3	8

There was a great proliferation of different prepackaged software in use. Of the 22 different types of accounting software, no single type was being used by more than three companies. Great Plains was being used by three companies, as was Peachtree and Real World. No other package was being used by more than two of the companies. A listing of the prepackaged software in use is shown in Table 3.

Table 3
Prepackaged Software Used

Type of Prepackaged Software Used	Number of Companies Using	Percent of Companies Using
Great Plains	3	10.0
Peachtree	3	10.0
Real World	3	10.0
IBM-Mapix	2	6.7
SBT	2	6.7
All Others	17 ^a	56.6
TOTAL	30	100.0

^aNone of the software packages in this category was used by more than one company.

The above research findings were consistent with research done previously. The February/March issue of *Computers in Accounting* revealed that no general ledger accounting package used by CPAs had more than 12 percent use (1). Write-Up Solution II had 12% use while Real World and Peachtree had 6 percent and 4 percent use, respectively. A survey of clients by the same magazine revealed that MAS 90 and Peachtree each had 14 percent usage whereas Real World and Great Plains had 8 percent and 5 percent usage, respectively. Another survey done in Illinois by *The Practical Accountant* mentioned none of the aforementioned CAIS Software packages (2).

It was expected that most of the companies would back up their data. The survey data revealed that all 50 companies back up their data on a regular basis, either daily or weekly. Only 8 percent of the companies do a back up on a monthly basis.

Demographic data was captured on the 65 individual respondents to the written questionnaire. Of the 65, 26 (40%) were male and 39 (60%) were female. The age brackets were fairly evenly distributed with 14 (21.5%) under twenty-nine years of age, 28 (43.1%) in their thirties, and 23 (35.4%) over thirty-nine. Forty-four (67.7%) of the individual respondents held a college degree, while 21 (32.3%) did not. The mean years of experience with computers was nine.

Computerized Accounting Information Systems

Of the 65 users of computerized systems, training came more from hands-on experience rather than formalized computer training. Forty-four (67.7%) of the respondents had not taken a college computer course, while the other 21 (32.3%) respondents had taken an average of 2.9 college computer courses. Thirty-five (53.8%) of the respondents had not taken a computer seminar, while the other 30 (46.2%) respondents had taken an average of 2.8 computer seminars. The great majority of the users spent over ten hours per week using a computer at work.

GENERAL FINDINGS

The most surprising finding of this study was that 53.8% of the companies surveyed by telephone were not using a computerized accounting information system. It is astonishing to find so many companies not taking advantage of the benefits derived from computerizing the accounting system, particularly with the reduction in cost of both hardware and software in recent years.

Also surprising was the use of modems by only 16% of the companies. This will surely increase in the very near future with the explosion currently underway with telecommunications.

Another interesting finding of this study was the number of networked microcomputers being utilized. By networking several microcomputers together, companies are realizing the advantages of communication and power at a relatively low cost.

The indication that there is no clear-cut frontrunner in the prepackaged accounting software market is also intriguing. Unlike other types of application software packages, such as spreadsheets, word processing, and database management systems, where there are usually a handful of popular packages to choose from, it seems that the proliferation of accounting software packages has led to a wide range of packages in use.

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TWO METHODS FOR TEACHING STUDENTS ABOUT RADIATION RISKS¹

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ABSTRACT

Two methods of teaching by example in the topic area of radiation risk are presented here. Both of these examples use everyday concepts to clarify complex scientific theories while keeping the student active in the learning process.

INTRODUCTION

In February of 1995, the Alabama Chapter of the Health Physics Society held a workshop for K-12 teachers in order to teach them more about radiation. This workshop, funded by a Department of Energy (DOE) grant, covered the fundamentals of radiation, sources of radiation, low-level radioactive waste, radiation effects, and included laboratory exercises. In Alabama, Henson et al. (1987) had previously held institutes for uncertified physics teachers to help them become certified. This workshop had a similar goal: to give physics (and other classroom teachers) useful information, curricular materials and teaching tips that would help them inform their students about the use of radiation in modern society.

I presented material on radiation risks at this workshop and was able to tell teachers about a number of teaching devices I have used over the years to teach students risk conceptually. One of the first questions students ask when presented with radiation concepts is "Is it safe?" This line of questioning can detract from the subject at hand; thus, it is often best to deal with this topic first. Students, like the general public, tend to view risks in terms of "good" or "bad," not realizing that there is such a thing as acceptable risk. Teaching about radiation risk involves using material from physics, biology from the cell to the organism, and epidemiology; this material is not always easy for students to comprehend.

As we know, methods of teaching that make effective use of analogy (teaching through examples) and promote student activity/discussion are superior to other

¹Manuscript received 8 May 1995; accepted 19 May 1995.

methods (Black, 1993). Examples should be novel (e.g., use different approaches), but also be credible and realistic (Yellon, 1987). Two of my examples to teach students about key concepts to radiation risk are presented here. They present complicated concepts in terms of everyday activities while making the student participate in the learning process.

THE LINEAR MODEL

The linear dose-response model is one of two basic models, with the nonlinear model. The linear model often assumes lack of a threshold (a level below which no effects occur) as well, meaning that the only "safe" dose is no dose at all. Although the linear dose-response model (Figure 1) is commonly used in radiation protection, it is only a possible model of dose-response and has its weaknesses. I ask students to critique the linear model based on the following statement:

The LD100 (lethal dose to 100% of the population) for aspirin is 100 tablets. That is, anyone who consumes 100 aspirin will die. However, it is of course common for any adult to take two aspirin for a headache.

The instructor can work students through the following logic. The linear model extrapolates the potential effects at low doses from high dose effects. Thus, if we accept the linear model for aspirin ingestion, then a direct linear extrapolation would hold that ingesting 2 aspirin would be fatal to 2% of the population (Starchman and Hedrick, 1993). Two of every 100 people who consumed 2 aspirin would die. Of course, we know that this is not the case.

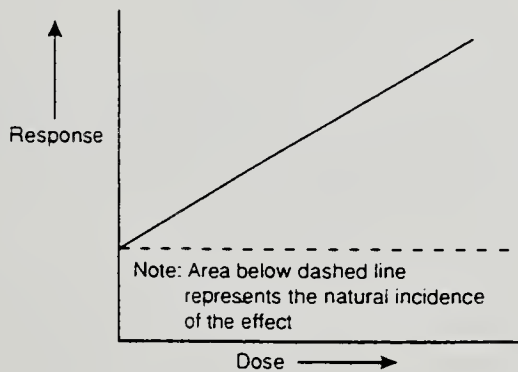


Figure 1. - The Linear Dose-Response Model

Note how as dose increases, effects increase. Also, the only totally "safe" dose is 0 (zero). With any other dosage, the effect *may* occur, even though it is to a very small percentage of the population

STOCHASTIC VERSUS NONSTOCHASTIC

To properly understand radiation risks, students need to know that low dose effects are stochastic (statistical) rather than non-stochastic in nature, and thus, constitute acceptable risk. In some texts, stochastic effects are called statistical effects or nondeterministic; nonstochastic, certainty or deterministic effects. Regardless of the terms we use, these opposite concepts remain difficult for students. There is a usable analogy for these effects.

This relates to the difference between investing money in the lottery or investing money in a bank. Lottery tickets may be bought for small amounts of money analogy = low radiation doses and non-threshold). There also is only a small chance of winning. Thus, buying lottery tickets is analogous to stochastic effects such as leukemia, which *may* occur from low doses of radiation but are *not likely* to occur.

On the other hand, one may invest one's money in the bank. This usually requires a minimum amount of money to open an account (threshold dose). If one invests money in the bank, there is a definite return, unlike lottery tickets (deterministic). This concept is shown graphically in Figure 2 (Dowd, 1994).

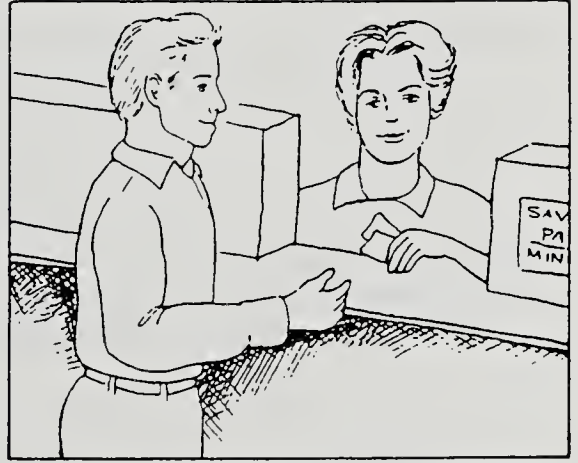
Two methods will keep the student active in learning here. First, the instructor could simply ask, "How do these two concepts relate to the difference between investing money and buying lottery tickets," leading them through the above logic. Second, one could present this material and then ask students to clarify it in their own words and/or critique the model.

CONCLUSION

This article reviewed two concepts often used in discussing radiation risk: the linear dose-response model and stochastic and nonstochastic effects. Teaching these concepts through analogy will facilitate student understanding, helping them to understand the role of radiation in our daily lives.



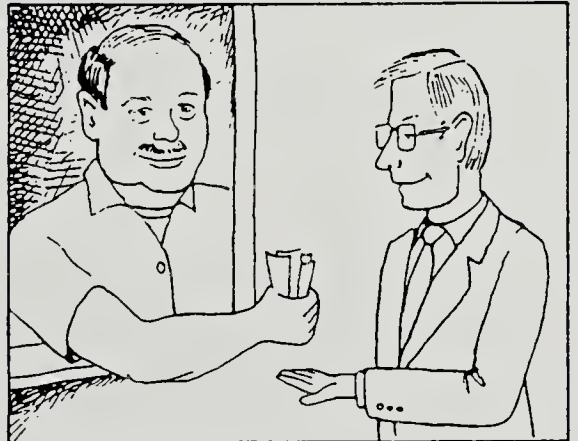
IF 100 PEOPLE INVEST \$100
IN A BANK AT 5% INTEREST...



...THEIR RETURN WILL BE \$105
(\$100 PLUS \$5). THIS IS AN EXAMPLE
OF A NONSTOCHASTIC EFFECT.
THE RETURN IS CERTAIN.



IF 100 PEOPLE BUY A LOTTERY
TICKET FOR \$1.00 EACH, THAT
PUTS \$100 IN THE POT TO BE
WON BY ONE PERSON.



99 PEOPLE WILL WIN NOTHING
IN THIS CASE, AND ONE PERSON
WILL WIN \$100. THIS IS AN
EXAMPLE OF A STOCHASTIC EFFECT.

Figure 2. - Illustration of Stochastic and Nonstochastic Effects

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INTERNATIONAL SCIENCE AND ENGINEERING FAIR
ALABAMA STUDENT WINNERS

Report by

*Mary Thomaskutty
ISEF Coordinator
State of Alabama*

Alabama took sixteen students to the International Science and Engineering Fair in Hamilton, Ontario (Canada). Out of these sixteen, four students won seven awards totaling \$4750.00 and an all expense paid trip to a NASA center for a student and his teacher. The following is a list of the four winners from Alabama:

Jeremiah Daniel Brown (14): Covenant Christian Academy
Huntsville, Alabama. Genetic Algorithm
Optimization of Lenses using Y-Y Diagram.

Award:

- 1) IEEE Computer Society -- Third Place (\$150.00)
- 2) Computer Science Category Award -- Fourth Place (\$500.00)

Dorek Alan Biglari (16): Covenant Christian Academy
Huntsville, Alabama. Multi-Axis Suspension
Seismometer.

Award:

- 1) Society of Exploration Geophysicists:
Distinguished Achievement Award -- (\$500.00) and an
engraved plaque to be presented to student's school.
- 2) Destiny in Space -- Lockheed/National Air and Space
Museum/IMAX: Second Award of (\$3,000.00).
- 3) Physics Category Award -- First Place (\$500.00)

James Michael Jeffers II (17): Sidney Lanier High School
Montgomery, Alabama. Simulated Acid
Rain on Corn Kerneal Production.

Special Award:

- 1) National Aeronautics and Space Administration
Expense-paid trip to NASA center for student
and teacher; certificate.

International Science and Engineering Fair

David Andrew Goldenbert (15): Altamont High School
Birmingham, Alabama. Native American
Ethnobotanical Remedies on Giardia in vitro.

Award:

- 1) Medicine and Health Category Award
Fourth Place and (\$100.00) cash award.

Notes

Notes

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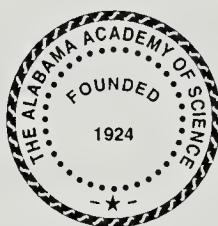
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THE FREE-RADICAL CHLORINATION OF PENTANE AND THE CHLOROBUTANES¹

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ABSTRACT

The free radical monochlorination of pentane and of 1- and 2-chlorobutane has been studied. The chlorination was effected at 79°C with sulfuryl chloride as the chlorine source and 2,2'-azobis-(2-methylpropionitrile) (AIBN) as the radical initiator. Product mixtures were analyzed by gas chromatography with a mass selective detector. The relative-reactivities for the different substitution sites were determined. Relative-reactivity is rationalized by consideration of hyperconjugative interactions between the carbon-radical and neighboring carbon-hydrogen and carbon-carbon σ -molecular orbital electron pairs. The effectiveness of hyperconjugative stabilization seems to be modulated by rotational-energy barriers experienced as neighboring σ -molecular orbital electron pairs become coplanar with the carbon radical's p-orbital electron. Experimental data suggest that a neighboring carbon-chlorine's σ -molecular orbital electron pair does not interact by hyperconjugation; nor does the chlorine significantly influence the carbon-radical's stability by inductive or by resonance interactions. Results suggest that a chlorine 1,4-neighboring group interaction does stabilize the radical. 1,3- and 1,5-Neighboring group interactions are not observed.

INTRODUCTION

It is well known that when atomic chlorine reacts with alkanes the relative reactivity towards substitution is: tertiary carbon > secondary carbon > primary carbon. However, when atomic chlorine reacts with a molecule already containing a halogen atom, the picture is less clear. Jerry March in the first edition of his text "Advanced Organic Chemistry: Reactions, Mechanisms, and Structure" summarizes our understanding by saying (page 529); "...simple generalizations cannot be made. In some cases, the expected inductive effect seems to be operating, and in others the neighboring-group effect gives mainly β substitution, but in still other cases, results

¹Manuscript received 3 August 1995; accepted 15 October 1995.

are obtained which defy simple explanations." This study was conducted to uncover structural and electronic influences in the free-radical substitution reactions effected by atomic chlorine.

METHOD AND RESULTS

A mixture of the substrate molecule, the free-radical initiator AIBN [2,2'-azobis-(2-methylpropionitrile)], and the chlorine source (sulfuryl chloride) was heated in refluxing ethanol (79°C) for five minutes. At this temperature the AIBN decomposed to give isobutylnitrile radicals which reacted with the sulfuryl chloride to generate chlorine radicals. To maximize monosubstitution the chlorine source was limited to molar amounts of 2% or less relative to the substrate molecule. Control studies showed that no substitution occurred when AIBN was absent. Typical reaction mixtures are given in Table 1.

Table 1. Typical Reaction Mixtures. All amounts: $\times 10^{-5}$ moles

<u>Substrate Molecule</u>	<u>Sulfuryl Chloride (SO₂Cl₂)</u>	<u>AIBN</u>
Pentane (1.1 mL) 971	19.8	2.7
1-Chlorobutane (1.0 mL) 920	13.3	1.9
2-Chlorobutane (1.1 mL) 971	14.0	2.2

After being heated, a reaction mixture was cooled in an ice bath, washed with water, washed with dilute sodium bicarbonate to remove acids, and finally was dried with anhydrous sodium sulfate. Analysis was performed by GC-MS using a Hewlett Packard 5890 Series II Gas Chromatograph with a 30 meter by 0.25 mm column having a 0.25 mm film thickness of crosslinked 5% phenylmethylsilicone. The detector was a Hewlett Packard 5971 Mass Selective Detector.

Pentane:

Three isomeric monochloropentanes were obtained from chlorination of pentane. The isomers were identified in the total ion chromatogram by their boiling points: the 4.47 minute peak as 2-chloropentane (b.p. 97°C), the 4.58 minute peak as 3-chloropentane (b.p. 98°C), and the 5.19 minute peak as 1-chloropentane (b.p. 108°C). The mass spectra were consistent with these monochloropentanes. Calculated Relative-Reactivity Factors (RRF=Observed relative % / Random %) indicated that substitution at site #1 (the primary carbon) was slower than

Free-Radical Chlorination of Pentane

substitution at sites #2 and #3. The RRF reflects the relative stability of the carbon-radical intermediate in the substitution reaction since product formation is under kinetic control. *A larger RRF for a site indicates greater stability for the carbon-radical intermediate and greater reactivity (faster rate) for substitution at that site.* The results are summarized in Table 2.

Table 2. Results of Pentane Reaction with Chlorine Free Radical

	Relative Percent Concentration		Relative-Reactivity Factor (RRF) ^b
	Observed ^a	Statistical	
1-chloropentane	23.1% ($\sigma_n = 0.30$)	50.00%	0.462
2-chloropentane	48.1% ($\sigma_n = 0.16$)	33.33%	1.443
3-chloropentane	28.8% ($\sigma_n = 0.16$)	16.67%	1.728

^a Average of five GC-MS analyses

^b The RRF is the ratio of the observed relative percent concentration divided by the statistically expected percent concentration.

1-Chlorobutane

Chlorination of 1-chlorobutane produced four isomeric dichlorobutanes which were easily separated and identified by GC-MS: 1,1-dichlorobutane (b.p. 114°C, 5.00 minute retention time), 1,2-dichlorobutane (b.p. 124°C, 5.28 min.), 1,3-dichlorobutane (b.p. 134°C, 5.60 min.), and 1,4-dichlorobutane (b.p. 162°C, 6.43 min.). The 1-chlorobutane monochlorination results are given in Table 3.

2-Chlorobutane

Chlorination of 2-chlorobutane produced four structurally isomeric dichlorobutanes. These were separated and identified by GC-MS. The elution sequence reflected the boiling points: 2,2-dichlorobutane (b.p. 104°C), 2,3-dichlorobutane (b.p. 116°C), 1,2-dichlorobutane (b.p. 124°C), and 1,3-dichlorobutane (b.p. 134°C). The racemic 2-chlorobutane starting material produced a pair of diastereomeric 2,3-dichlorobutanes. The diastereomers were separated by gas

Table 3. Results of 1-Chlorobutane Reaction with Chlorine Free Radical

	Relative Percent Concentration		Relative-Reactivity Factor (RRF) ^b
	Observed ^a	Statistical	
1,1-dichlorobutane	6.41% ($\sigma_n = 0.47$)	22.22%	0.288
1,2-dichlorobutane	42.86% ($\sigma_n = 0.70$)	22.22%	1.929
1,3-dichlorobutane	34.86% ($\sigma_n = 0.38$)	22.22%	1.569
1,4-dichlorobutane	15.87% ($\sigma_n = 0.58$)	33.33%	0.476

^a Average of five GC-MS analyses

^b The RRF is the ratio of the observed relative percent concentration divided by the statistically expected percent concentration.

chromatography (4.89 and 5.10 minute retention times under our conditions), and the areas of these two peaks were combined in the analysis. The results are summarized in Table 4.

Table 4. Results of 2-Chlorobutane Reaction with Chlorine Free Radical

	Relative Percent Concentration		Relative-Reactivity Factor (RRF) ^b
	Observed ^a	Statistical	
1,2-dichlorobutane	8.51% ($\sigma_n = 0.69$)	33.33%	0.255
2,2-dichlorobutane	24.18% ($\sigma_n = 0.50$)	11.11%	2.176
2,3-dichlorobutane	44.62% ($\sigma_n = 0.60$)	22.22%	2.008
1,3-dichlorobutane	22.69% ($\sigma_n = 0.39$)	33.33%	0.681

^a Average of five GC-MS analyses

^b The RRF is the ratio of the observed relative percent concentration divided by the statistically expected percent concentration.

INTERPRETATION OF RESULTS

Results are summarized in Table 5 in which the eleven different substitution sites are listed by groups according to the number of hyperconjugating electron pairs. Within each group the sites are placed in order of increasing Relative-Reactivity Factor.

Hyperconjugation

Table 5 reveals that the stability of the radical (and thus the site's RRF value) is significantly influenced by hyperconjugation between the carbon-radical and adjacent carbon-hydrogen and carbon-carbon σ -molecular orbital electron pairs. Case (A) with two hyperconjugating pairs is the least relative site (RRF of 0.255); and case (K) with six hyperconjugating pairs is the most reactive site (RRF of 2.176).

It appears that a carbon radical is not stabilized by hyperconjugation with an adjacent carbon-chlorine σ -molecular orbital electron pair. This is revealed by comparing case (A) (RRF=0.255), in which the chlorine is in position to hyperconjugate with the radical, and case (D) (RRF=0.476), in which the chlorine is more distant. Case (A) and case (D) should have similar RRF values (since both have three hyperconjugating electron pairs) if in case (A) the adjacent carbon-chlorine σ -bond electrons were stabilizing the carbon radical. They should be more like cases (C) and (D). The observation that case (A) has a smaller RRF suggests that the carbon-chlorine σ -bond does not hyperconjugate with the radical. Kawamura, Edge, and Kochi have reported esr observations made on the β -chloroethyl radical which indicate that the odd electron is delocalized onto orbital(s) around the chlorine nucleus. The observed RRF value for Case (A) suggests that (in our reactions at 79°C) whatever this delocalization might be, it does not enhance the reactivity (stability) of the carbon radical to the extent that a carbon-hydrogen hyperconjugative interaction does. Hyperconjugation by β -chlorine is possible also in cases (F) and (G). The larger RRF values for these cases might be due simply to the greater number of C-H and C-C hyperconjugative interactions, although stabilization by hyperconjugation with the β -chlorine cannot be ruled out.

It is also obvious from Table 5 that there must be influences on the radicals' stability other than simply the number of hyperconjugating C-H and C-C electron pairs. What might these other influences be?

Hyperconjugation Modulated by Rotational Barriers

Cases (B), (C) and (D) each have three hyperconjugating electron pairs. Why does case (B) have a smaller RRF? Adjacent σ -molecular orbital electron pairs must be coplanar with the radical's p-electron for hyperconjugation to occur. Figure 1 illustrates structures for the radical intermediates of cases (D) and (B). Energy barriers are encountered as rotation takes place around the carbon-carbon bond to

Table 5. Results Summary: Free Radical Substitution by Chlorine.

Case	Radical Site	Molecule	RRF	Number of Hyperconjugating Electron Pairs			Rotational Barrier: Maxi- mum Energy (kcal/mole)
				C-H	C-C	C-Cl	
(A)	atom #1	2-Cl-butane	0.255	1	1	1	0.8
(B)	atom #1	1-Cl-butane	0.288	2	1	0	7.0
(C)	atom #1	pentane	0.462	2	1	0	1.0
(D)	atom #4	1-Cl-butane	0.476	2	1	0	1.05
(E)	atom #4	2-Cl-butane	0.681	2	1	0	1.2
(F)	atom #2	1-Cl-butane	1.929	4	1	1	4.5 ^a
(G)	atom #3	2-Cl-butane	2.008	4	1	1	3.8 ^b
(H)	atom #2	pentane	1.443	5	1	0	3.3 ^c
(I)	atom #3	1-Cl-butane	1.569	5	1	0	6.6 ^b
(J)	atom #3	pentane	1.728	4	2	0	1.3
(K)	atom #2	2-Cl-butane	2.176	5	1	0	1.35 ^c

^a For rotation around the C#1-C#2 bond [C#2-C#3 bond has max. rotational barrier of 1.3 kcal/mole]

^b For rotation around the C#2-C#3 bond [C#3-C#4 bond has max. rotational barrier of 0.35 kcal/mole]

^c For rotation around the C#2-C#3 bond [C#1-C#2 bond has max. rotational barrier of 0.35 kcal/mole]

bring adjacent carbon-hydrogen and carbon-carbon bonds into alignment for hyperconjugation. Calculations of these energy barriers were made using the HyperChem Computational Chemistry Program by Hypercube, Inc. (Note that in these calculations the torsion angle having the lowest energy was assigned a zero kcal/mole value, and energies at other angles are relative to this zero.) The calculated rotational energies are shown in Figure 2, and it is obvious that rotation in case (B) is restricted by the 7.0 kcal/mole barrier. As coplanarity becomes more difficult and is less frequent, hyperconjugative stabilization of the radical is diminished. And so, Case (B) has a smaller RRF than do cases (C) and (D).

We observe a similar modulation of hyperconjugation in cases (H) and (J). Structures for the radical intermediates of these two substitution sites in pentane are shown in Figure 3. The calculated energy profiles as rotation takes place around the illustrated carbon-carbon bonds are shown in Figure 4. The higher rotational barrier in case (H) (3.3 kcal/mole compared to 1.3 kcal/mole) diminishes the effectiveness of hyperconjugative stabilization and results in less substitution at the carbon site #2 of pentane (RRF=1.443 for site #2, compared to RRF=1.728 for site #3 of pentane).

Cases (J) and (K) have similar rotational energy barriers and each is stabilized by six hyperconjugating electron pairs. What can give rise to the difference in their relative reactivity factors? Figure 5 shows the structure for the radical intermediate of case (K) and its calculated rotational energy profile. A comparison of the rotational energy profiles for cases (J) and (K) reveals that, although the maxima for both are similar (1.3 and 1.35 kcal/mole), in case (J) 56% of the rotational profile is below the 1.0 kcal/mole level whereas in case (K) 85% remains below the 1.0 kcal/mole level. This overall lower rotational energy profile results in a larger RRF for case (K).

1,4-Neighboring Group Interaction

In cases (D) and (E) substitution is taking place on site #4 of the 1-chloro- and 2-chlorobutanes. In both cases the radical has three hyperconjugating electron pairs, and the rotational barriers are similar. The observation that Case (E) has a 30% larger RRF reveals that some stabilization of its carbon radical intermediate is occurring. This result suggests that in case (E) a stabilizing 1,4-neighboring group interaction is taking place between a non-bonding electron pair on the γ -chlorine atom and the odd electron in the carbon radical's p-orbital. Edge and Kochi have argued from esr observations that p-p homoconjugation occurs in the γ -chloropropyl radical between the odd electron and a lone pair orbital on chlorine.

Inductive and Resonance Interactions

In case (A) the chlorine is one atom removed from the carbon radical. In case (B) the chlorine atom is bonded directly to the carbon radical. The similarity of the

RRF values for these two cases suggests that inductive effects of chlorine are not significantly influencing the carbon radical. Inductive effects are expected to be slight since the radical intermediate carries no electric charge. The slightly larger RRF value for case (B) is attributed to the additional C-H hyperconjugating electron pair, although - as we have seen, the RRF value is diminished somewhat (from the expected 0.47 value) by the high rotational barrier.

It is well established from studies of electrophilic substitution on chlorinated aromatic systems that chlorine is able to stabilize a carbocation intermediate by resonance contribution of electron density. Our observations suggest that a resonance interaction between chlorine and the carbon-radical intermediate is not significant. The very similar values for RRF in cases (A) and (B), and also in cases (G) and (K), indicate that resonance is not significantly stabilizing the carbon radical. Resonance would be possible in cases (B) and (K) where the chlorine atom is bonded directly to the carbon-radical intermediate. Were resonance significant then considerably different RRF values might be observed. The slightly larger RRF values for case (B) with respect to (A), and for case (K) with respect to (G), are attributed to the additional hyperconjugating electron pair in each case.

1,3- and 1,5-Neighboring Group Interactions

A possible 1,3-neighboring group interaction could occur in case (A). Were a non-bonding electron pair of the β -chlorine atom to stabilize the carbon radical by p-p homoconjugation then an enhanced rate of substitution would be observed at the radical site. The observation that case (A) is the least reactive suggests that a chlorine 1,3-neighboring group interaction is not significant. Again, although Kawamura, Edge, and Kochi have reported esr observations indicating delocalization in the β -chloroethyl radical, the observed small RRF value for Case (A) suggests that (in our reactions at 79°C) whatever this delocalization might be, it does not enhance significantly the stability (reactivity) of the carbon radical.

A possible 1,5-neighboring group interaction could occur in case (D). However, the observation that the RRF is almost identical with that of case (C) in which the chlorine is absent suggests that a δ -chlorine interaction does not significantly stabilize the radical. This is consistent with the results of Edge and Kochi whose esr studies found no evidence for interactions in δ -, ϵ -, ω - halogen-substituted alkyl radicals.

ACKNOWLEDGMENTS

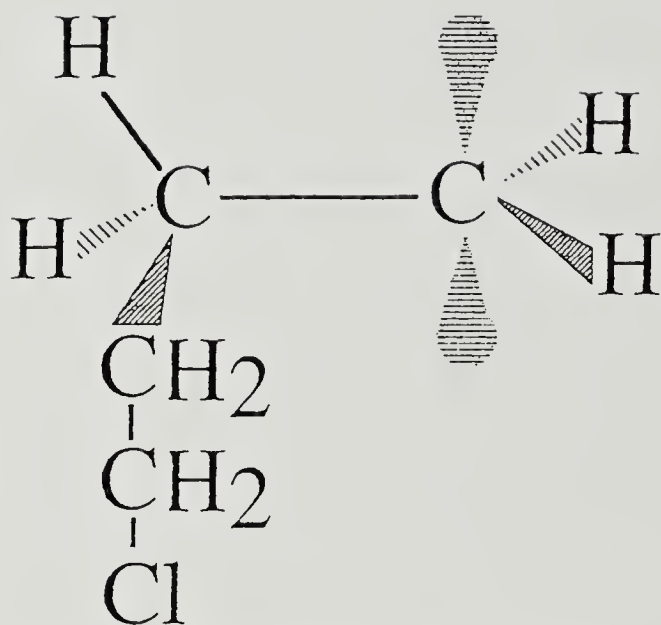
This work was supported by a faculty research grant from Spring Hill College. I thank Dr. E. Alan Salter and Margaret Gordon VanLoock for calculations of the rotational energy profiles.

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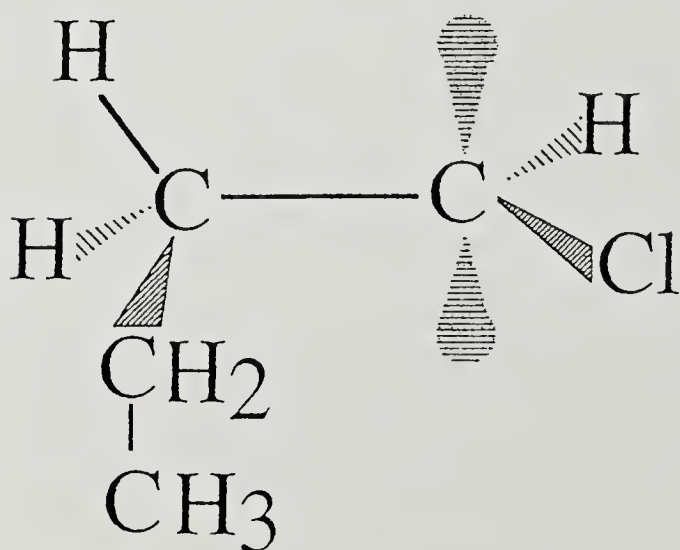
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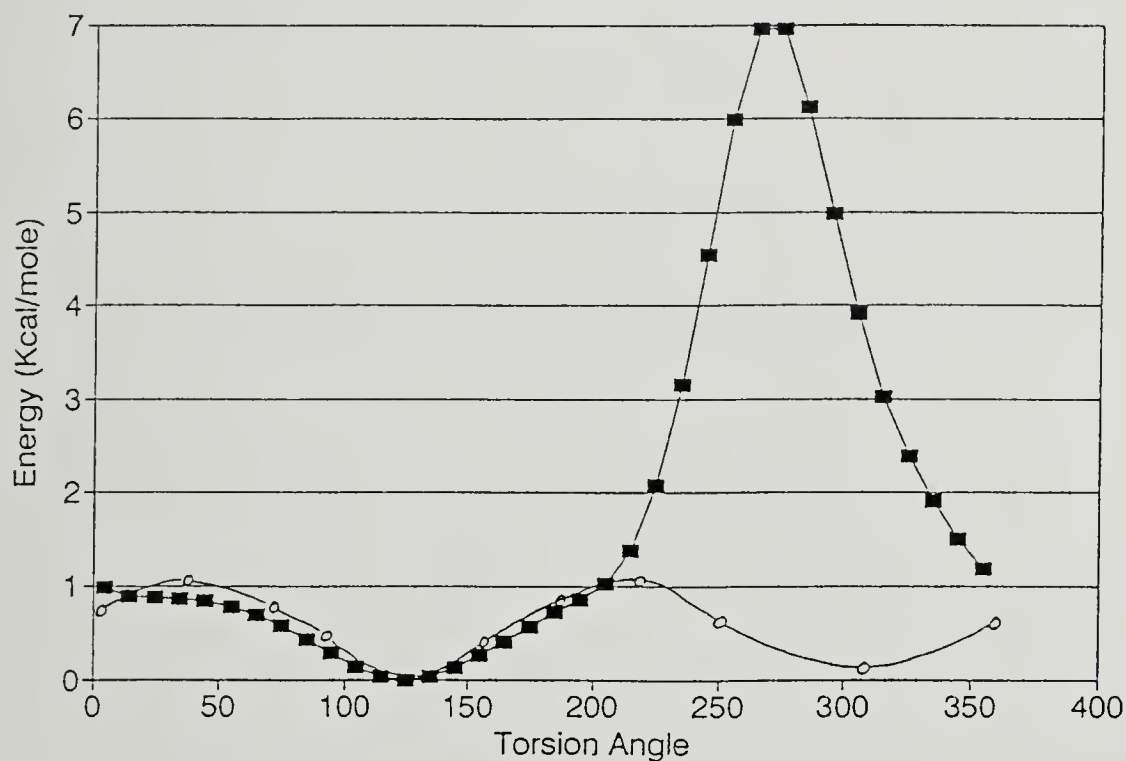
Case (D): Site #4, 1-Chlorobutane



Case (B): Site #1, 1-Chlorobutane

Figure 1. Perspective drawings for Cases (D) and (B) illustrating origin of rotational energy barriers.

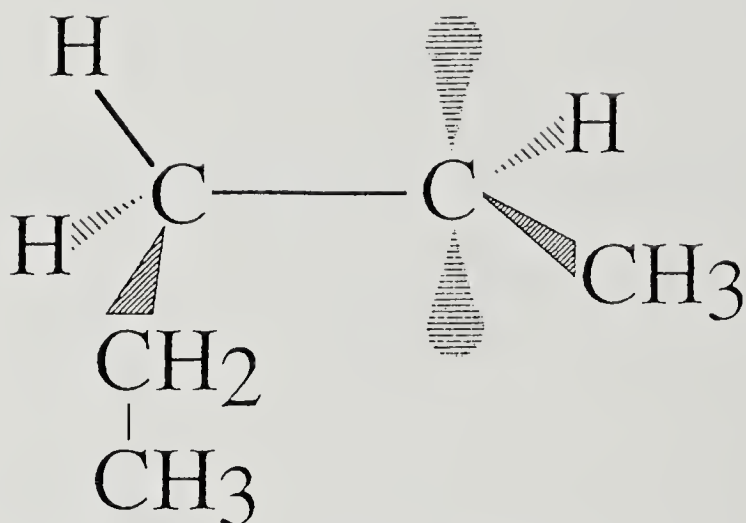
Rotational Energy Changes



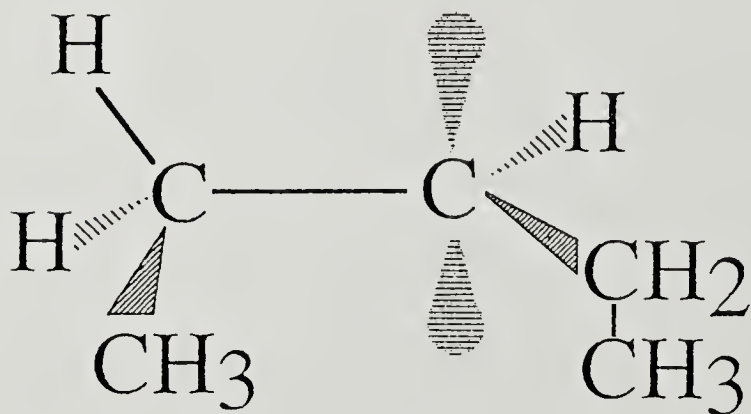
○ Case (D): Site #4, 1-Chlorobutane

■ Case (B): Site #1, 1-Chlorobutane

Figure 2. Rotational Energy Profiles for Case (D) and Case (B).



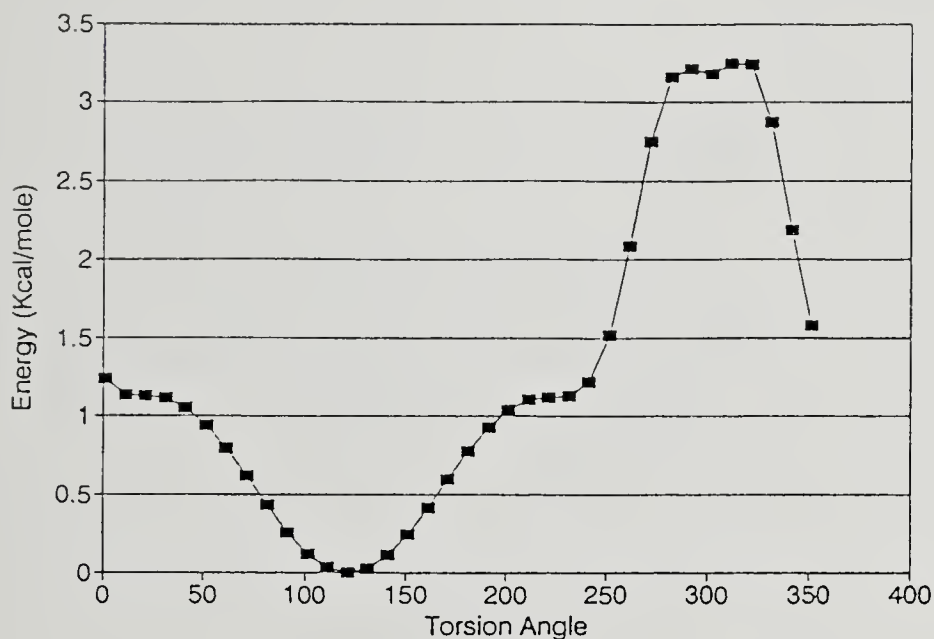
Case (H): Site #2, Pentane



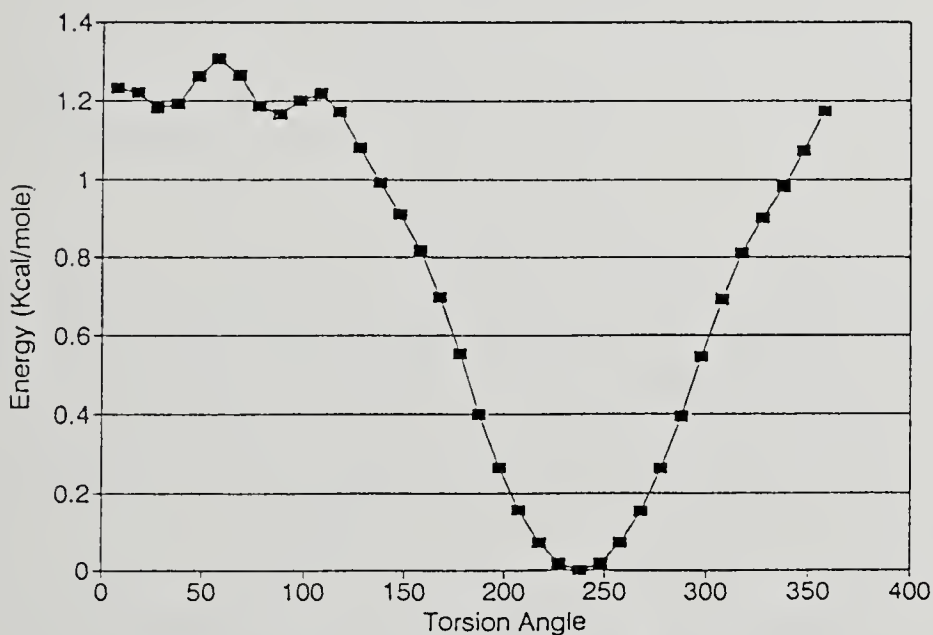
Case (J): Site #3, Pentane

Figure 3. Perspective drawings for Cases (H) and (J) illustrating origin of rotational energy barriers.

Free-Radical Chlorination of Pentane

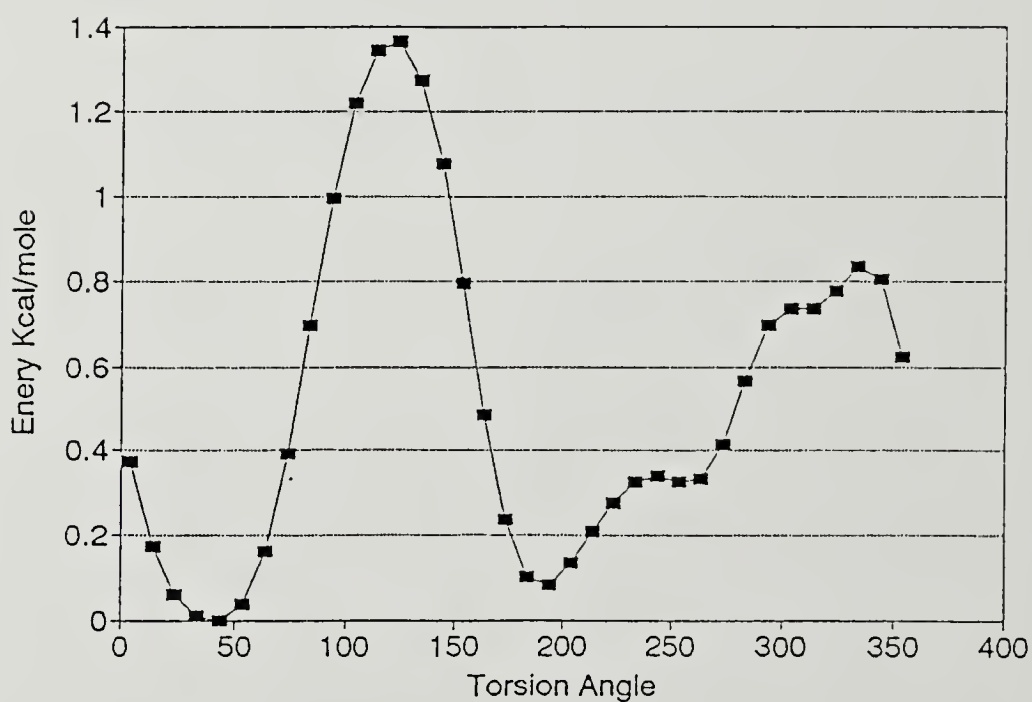
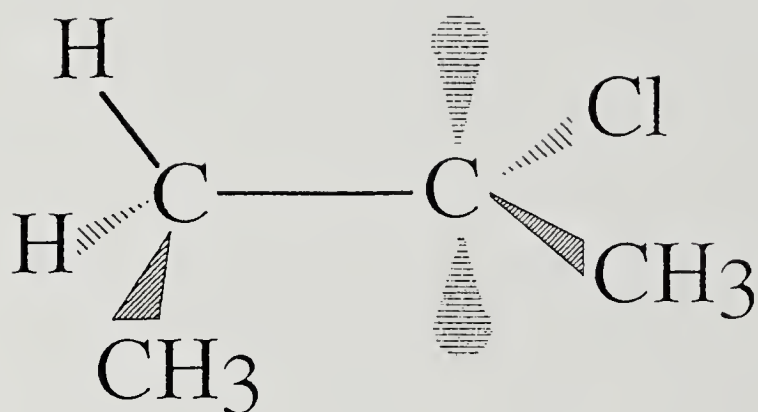


Case (H): Site #2, Pentane



Case (J): Site #3, Pentane

Figure 4. Rotational Energy Profiles for Case (H) and Case (J).



Case (K): Site #2, 2-Chlorobutane

Figure 5. Perspective Drawing for Case (K) Radical Structure and Rotational Energy Profile.

THE FOSSIL HOLDINGS OF THE ANNISTON MUSEUM OF NATURAL HISTORY¹

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"Money and books...and goods...and buildings...can all be replaced...but collections, I fear never!" - J.W. Michels, after losing his collection in a fire.

ABSTRACT

The Anniston Museum of Natural History has accumulated a sizeable collection of fossils over the last thirty years. Donated by amateur collectors, they sat uncatalogued until 1993, when a systematic cataloguing of all the museum's fossils began. The collection totaled 409 specimens, which have now been identified taxonomically and have had relevant information recorded onto the museum's current computer accession database.

INTRODUCTION

The science of paleobiology depends primarily on the establishment of collections. Indeed, without the accessibility of museum collections it is doubtful as to whether the science of paleobiology would have evolved at all. Unlike other sciences, paleobiology is uniquely dependent on "the specimen." It is the foundation of the science. There is often no inherent biology left for the paleobiologist to study other than that of form. The nuances of behavior, the chemistry of ecology, and most of the internal structures are lost; some of these traits can be deduced only by observations of and conclusions drawn from the specimens at hand. To be of any useful research value, any fossil collection must be organized into a logical, comprehensible system.

The only accredited museum in Alabama with a paleobiology collection is the Anniston Museum of Natural History (American Association of Museums, 1994). Left uncatalogued, this collection is insufficient to reflect the paleobiological resources offered by the state of Alabama, which boasts fossil assemblages ranging from the

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earliest Paleozoic to the latest Cenozoic. It is for these reasons that we undertook the first effort to catalogue the museum's fossils.

History

The first donor information comes from the mid 1960's, the fossils having been donated by members of the original board of directors of the museum (the most prolific donor of these, G.B. Daniell, donated fossils from all over North America). When the museum moved to its current location in 1976, donations to the paleobiology collection increased. However, due to staff shortages, no effort was made to identify or catalogue the fossils. The first fossils were put on display with the opening of the museum's Dynamic Earth exhibit in 1992, drawing attention to the collection as an educational tool. So it was, in 1993 that Jacksonville State University was first consulted about working on the collection.

MATERIALS AND METHODS

As most of the specimens were originally unidentified or misidentified, the first priority was proper identification. For this both general field guides and taxa-specific paleobiologic indices were employed (Benton, 1990; Boardman, et. al., 1987; Briggs and Crowther, 1990; Fenton and Fenton, 1990; Murray, 1985; Stewart and Rothwell, 1993; Thompson, 1982). Identification to the level of genus was dependent on specimen condition. This taxonomic information was recorded onto the museum's catalog worksheets along with all donor, origin, accession information, and physical descriptions and measurements. This worksheet is kept as part of a file for each specimen. The file also includes a gift agreement or receipt (depending on how the item was procured by the museum) establishing legal title to the item by the museum, and any additional material accompanying each specimen. Once completed, all information from the worksheets is entered into Accession 2.5™, the museum's current accession program, via a Macintosh Quadra 660 AV.

RESULTS

Table 1 lists all specimens currently curated at the museum. Data include catalog number, common name or description, scientific or taxonomic classification, age of the specimen, and where the specimen was found. The catalog number provides information about the accessioned item. For example, for the accession number 86.56.1, "86" represents the year (1986) when the museum came into possession of the specimen. The second number, "56", represents the fifty-sixth donation to the museum during that year. The last number identifies each individual item within a donation. For example, item number one is "86.56.1", item two is "86.56.2", and so forth.

There are currently 409 accessioned specimens at the museum. This number will certainly increase as new donations arrive and are catalogued (forty new specimens have been donated since this paper was written). Of the 409 accessioned specimens, 85% originate from the Paleozoic Era (between 570 and 225 mya), 13% from the Cenozoic (65 mya-present); and only 2% date to the Mesozoic (225-65 mya).

When the collection is subdivided taxonomically, the majority of the fossils are those of marine invertebrates: echinoderms, 11%; arthropods, 3%; molluscs, 5%; brachiopods, 15%; bryozoans, 4%; cnidarians, 10%. Other groups dominating the collection include pteridosperms (19%), and lycopods (13%), representing the Carboniferous plants commonly found in the rocks of Alabama's coal mines. The remaining twenty percent of the collection is composed of various chordate, vascular plant, and trace fossils.

DISCUSSION

As part of an organized, catalogued collection, the fossils of the Anniston Museum of Natural History may now be employed as a genuine research tool, available to any student of paleobiology. Not only reflecting the paleobiology of Alabama, the collection includes fossils from several well-known sites in North America. These sites include: the Francis Creek (Mazon Creek) Shales of Wilmington, Illinois, which boast some of the most uniquely preserved Carboniferous plants in the world; the Green River Formation in Wyoming, which has produced some of the most perfectly preserved Eocene fish fossils in North America, and, from the Wheeler Shale Formation, an exquisitely preserved trilobite, for which the area is renowned.

The Anniston Museum of Natural History is in the middle of renovating its Collections Management Area, after which time the fossils and all other museum acquisitions will be stored in state-of-the-art archival storage cabinets. Such an upgrade in facilities will add to the value of the paleobiology collection by supporting its long-term preservation.

It has been proposed that the entire collection be placed on-line for long-distance access by other museums and universities. This would no doubt increase the collection's usefulness, both to the museum, and other institutions. However, the reluctance of museums to lay themselves bare by allowing free access to all knowledge regarding their collections casts a shadow over this prospect.

Collections such as these are important because many paleobiological investigations are done in museums. While the work of field collection is no doubt important, may significant discoveries occur when the specimens are compared to extensive collections. Such a collection is now beginning to take shape at the Anniston Museum of Natural History.

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Anniston Museum of Natural History

Table 1. Fossil accessions of the Anniston Museum of Natural History (Ordered by Catalog Number)

Catalog #	Common name/Description	Taxonomic Classification	Origin	Age
1965.01.01	Trilobite	<i>Pseudogygites</i>	Cedar Bluff, Cherokee County, AL; Conasagua Formation	Cambrian
1966.01.01	Coral	<i>Acrocyathus</i>	Western LA	Carboniferous
1967.01.01	Brachiopod	Superfamily Orthacea	Weaver, Calhoun County, AL; Conasagua limestone	Cambrian
1967.02.01	Brachiopod	Superfamily Orthacea	White Plains, AL; Wedowee Formation	Silurian/Ordovician
1967.03.01	Coral	<i>Acrocyathus</i>	Anniston; Calhoun County, AL; Conasagua limestone	Carboniferous
1967.03.02	Coral	<i>Acrocyathus</i>	Anniston; Calhoun County, AL; Conasagua limestone	Carboniferous
1967.06.01	Brachiopod	Order Orthida	White Plains, AL; Wedowee Formation	Silurian/Ordovician
1968.01.01	Lycopod	<i>Lepidodendron</i>	Madison County, AL; Bangor limestone	Carboniferous
1968.06.01	Brachiopod	Family Hapsiphyllidae	Sumatanga, AL	Paleozoic
1968.09.01	Coral	<i>Lithostrotion</i>	Madison County, AL; Bangor limestone	Carboniferous
1968.10.01.a-b	Crinoid stem	Subphylum Crinoidea	Sumatanga, AL	Paleozoic
1969.01.01	Crinoid stem	Subclass Camerata	Madison County, AL; Bangor limestone	Carboniferous
1970.01.01	Horseshell; Seed tern	<i>Sphenophyllum</i> ; <i>Neuropteris</i>	Huntsville, Madison County, AL; Ste. Genevieve limestone	Carboniferous
1970.02.01	Brachiopod	Superfamily Plectambonitacea	unknown	Carboniferous
1970.03.01	Coral	<i>Acrocyathus</i>	unknown	Carboniferous
1970.04.01	Seed fern	<i>Alethopteris</i>	unknown	Carboniferous
1970.05.01	Coral	<i>Heliophyllum</i>	unknown	Carboniferous
1970.06.01	Brachiopod	Class Articulata	Slayden, TN	Devonian
1970.07.01.b	Brachiopods	<i>Zygospira</i>	Chatchee, Calhoun County, AL; Odenville limestone	Silurian/Ordovician
1970.08.01	Brachiopods	<i>Dolerorthis</i> ; <i>Rhipidomella</i>	unknown	Ordovician
1970.09.01	Crinoid stem	Class Crinoidea	unknown	Silurian/Ordovician
1970.10.01.a-b	Coral	<i>Acrocyathus</i>	unknown	Carboniferous
1970.11.01.g	Brachiopods	<i>Onniella</i> ; <i>Strophomona</i> ; <i>Strophonella</i> ; <i>Platystrophia</i>	Dayton, OH	Carboniferous
1970.12.01	Horn coral	<i>Grewingkia</i>	Dayton, OH	Ordovician
1970.12.01.p	Bryozoan	<i>Rhombolrypa</i>	Dayton, OH	Ordovician
1971.01.01	Brachiopod	<i>Mucrospirifer</i>	unknown	Devonian
1971.02.01	Bivalve	Superfamily Ostreacea	Reform, Pickens County, AL; Tuscaloosa Formation	Cretaceous
1971.03.01.a-b	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Carboniferous
1971.03.01.b	Fern	<i>Pecopteris</i>	unknown	Carboniferous
1971.09.01	Bivalve	<i>Chama</i>	Calhoun County, AL	Carboniferous
1972.01.01	Seed fern	<i>Alethopteris</i>	Scranton, PA	Carboniferous
1976.107.01	Fossilized algae	Kingdom Prolista	unknown	Carboniferous
1976.144.01	Permineralized wood	Division Tracheophyta	unknown	Carboniferous
1976.59.01.e	Crinoid stem	Class Crinoidea	unknown	Carboniferous
1976.60.01	Echinoid test	<i>Hemiasler</i>	Tarrant County, TX	Carboniferous
1976.61.01	Crinoid stem	Class Crinoidea	unknown	Carboniferous
1976.63.01.e	Blastoid	<i>Pentremites</i>	unknown	Carboniferous
1976.64.01	Blastoid	<i>Pentremites</i>	Lookout Mountain, TN	Carboniferous
1976.65.01	Crinoid stem	Class Crinoidea	unknown	Carboniferous
1976.66.01	Trilobites	<i>Elrathia kingii</i> ; <i>Peronopsis interstricta</i>	Millard County, UT; Wheeler Shale Formation	Carboniferous
1976.67.01	Crinoid stem	Class Crinoidea	unknown	Carboniferous

Table 1. Fossil accessions of the Annision Museum of Natural History (Ordered by Catalog Number)

1976.68.01	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.02	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.03	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.04	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.05	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.06	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.07	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.08	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.68.09	Crinoid stem	Class Crinoidea	unknown	unknown	unknown
1976.69.01.n	Bryozoan	<i>Archimedes</i>	unknown	Carboniferous	
1976.70.01	Coral	Family Streptelasmalinae	Fort Payne, AL; Pottsville Formation	Carboniferous	
1976.71.01	Crinoid stem	Class Crinoidea	Jack County, TX; Adam's Branch limestone	Carboniferous	
1976.72.01	Crinoid stem	Class Crinoidea	Weaver, Calhoun County, AL; Chepultepec dolomite	Ordovician	
1976.74.01	Fish	Order Clupeiformes	Green River, WY; Green River Formation	Eocene	
1976.75.01.c	Bivalve	Superfamily Nuculacea	unknown	unknown	
1976.76.01	Crinoid stem	Class Crinoidea	unknown	unknown	
1976.77.01	Calamite	<i>Calamites</i>	unknown	Carboniferous	
1976.78.01	Marine invertebrates	Phyla: Echinodermata, Brachiopoda, Bryozoa	unknown	Silurian	
1976.78.01.d	Marine invertebrates	Superfamily Orthacea; Archimedes; Class Crinoidea	unknown	Silurian	
1976.78.02	Marine invertebrates	Phyla: Echinodermata, Brachiopoda, Bryozoa	unknown	Silurian	
1976.78.03	Marine invertebrates	Phyla: Echinodermata, Brachiopoda, Bryozoa	unknown	Silurian	
1976.78.04	Marine invertebrates	Phyla: Echinodermata, Brachiopoda, Bryozoa	unknown	Silurian	
1976.79.01	Leaf impression	Class Magnoliopsida	unknown	Cenozoic	
1976.80.01	Brachiopod	Family Athrydacea	unknown	Silurian/Ordovician	
1976.82.01	Horn coral	<i>Syringopora</i>	unknown	unknown	
1976.84.01	Coral	<i>Lithostrotionella</i>	unknown	Carboniferous	
1976.85.01	Plant impression-compressions	<i>Sphenophyllum</i> ; <i>Pecopteris</i> ; <i>Neuropteris</i>	unknown	Carboniferous	
1976.86.01.a	Marine invertebrates	Class Articulata; Class Stenolaemata	unknown	Ordovician	
1976.86.02 b	Bryozoan	<i>Rhomboleptys</i>	unknown	Ordovician	
1976.87.01	Opalized wood	Division Tracheophyta	Goldfield	Tertiary	
1979.05.01	Permineralized wood	Division Tracheophyta	Ralph, Tuscaloosa County, AL; Tuscaloosa Formation	Cretaceous	
1980.02.01.c	Marine invertebrates	Archimedes; Class Crinoidea; Subclass Rugosa	Little River Canyon, AL; Pottsville Formation	Carboniferous	
1980.19.01	Seed fern	<i>Lyginopteris</i>	Birmingham, AL	Carboniferous	
1980.19.02	Seed fern	<i>Lyginopteris</i>	Birmingham, AL	Carboniferous	
1980.19.03	Seed fern	<i>Lyginopteris</i>	Birmingham, AL	Carboniferous	
1980.19.04	Seed fern	<i>Lyginopteris</i>	Birmingham, AL	Carboniferous	
1980.19.05	Seed fern	<i>Lyginopteris</i>	Birmingham, AL	Carboniferous	
1980.19.06	Seed fern	<i>Lyginopteris</i>	Birmingham, AL	Carboniferous	
1981.19.01	Calamite	<i>Calamites</i>	Calhoun County, AL; Pottsville Formation	Carboniferous	
1981.19.02	Lycopod	Class Lycopsidea	Calhoun County, AL; Pottsville Formation	Carboniferous	
1981.19.03	Seed fern	<i>Alloiopteris coralloides</i>	Calhoun County, AL; Pottsville Formation	Carboniferous	
1981.19.04	Lycopod	<i>Lepidodendron</i>	Calhoun County, AL; Pottsville Formation	Carboniferous	
1981.19.05	Lycopod	<i>Lepidodendron</i>	Calhoun County, AL; Pottsville Formation	Carboniferous	
1981.19.05.f	Lycopod	<i>Lepidodendron</i>	Calhoun County, AL; Pottsville Formation	Carboniferous	

Anniston Museum of Natural History

Table 1. Fossil accessions of the Anniston Museum of Natural History (Ordered by Catalog Number)

1981.19.06	Lycopod	<i>Lepidodendron</i>	Calhoun County, AL; Pottsville Formation	Carboniferous
1981.19.07	Seed fern	<i>Neuropteris</i>	Calhoun County, AL; Pottsville Formation	Carboniferous
1981.19.08	Seed fern	<i>Neuropteris</i>	Calhoun County, AL; Pottsville Formation	Carboniferous
1981.19.09	Lycopod	<i>Lepidodendron</i>	Calhoun County, AL; Pottsville Formation	Carboniferous
1985.04.01.b	Trilobites	<i>Pseudogigites</i>	Orillia, Ontario, Canada	Ordovician
1985.05.01	Permineralized wood	Division Tracheophyta	Elmore County, AL; Tuscaloosa or Eulaw Formations	Cretaceous
1985.06.01	Horn coral	Order Sauridae	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.05	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.05	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.06	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.07	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.08	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.09	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.10	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.11	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.12	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.13	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.14	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.16.a-b	Crinoid stem	Class Crinoidea	Anniston, Calhoun County, AL; Chepultepec dolomite	Ordovician
1985.06.17	Crinoid stem	Class Crinoidea	Calhoun County, AL	Silurian/Ordovician
1985.06.17	Crinoid stem	Class Crinoidea	Calhoun County, AL; Conasagua limestone	unknown
1985.06.18	Crinoid stem	Class Crinoidea	Calhoun County, AL	Silurian/Ordovician
1985.06.19	Marine invertebrates	Phylum Echinodermata; Phylum Bryozoa	unknown	unknown
1985.06.19	Marine invertebrates	Phylum Echinodermata; Phylum Bryozoa	unknown	Silurian/Ordovician
1985.06.2.d	Brachiopods	Phylum Brachiopoda	unknown	unknown
1985.06.20	Shark tooth	<i>Carcharodon</i>	Florida	Miocene
1985.06.20.a-b	Shark teeth	Class Chondrichthyes	unknown	Miocene
1985.06.21	Shark tooth	<i>Scapanorhynchus</i>	Florida	Miocene
1985.06.22	Lycopod	<i>Lepidodendron</i>	Birmingham, AL; Floyd shale	Carboniferous
1985.06.22.y	Lycopods	<i>Lepidodendron</i>	Birmingham, AL; Floyd shale	Carboniferous
1985.06.23	Lycopod	<i>Lepidodendron</i>	Birmingham, AL; Floyd shale	Carboniferous
1985.06.24	Lycopod	<i>Lepidodendron</i>	Birmingham, AL; Floyd shale	Carboniferous
1985.06.25	Lycopod	<i>Lepidodendron</i>	Birmingham, AL; Floyd shale	Carboniferous
1985.06.26	Permineralized wood	Division Tracheophyta	unknown	Carboniferous
1986.10.01	Trilobite	<i>Pseudogigites</i>	Orillia, Ontario; Canada	Ordovician
1986.11.04	Permineralized wood	Division Tracheophyta	Warren County, MS	Miocene
1986.12.01	Calamite stem	<i>Mesocalamites</i>	Carbondale, IL	Carboniferous
1986.12.02	Calamite stem	<i>Mesocalamites</i>	Carbondale, IL	Carboniferous
1987.02.01	Marine invertebrates	Phyla: Brachiopoda, Bryozoa, Cnidaria	Giles County, TN	Carboniferous
1987.03.01.b	Permineralized wood	Division Tracheophyta	Elmore County, AL; Tuscaloosa or Eulaw Formations	Cretaceous
1987.25.01.a-c	Brachiopods	<i>Rafinesquina</i>	Orillia, Ontario; Canada	Ordovician
1987.32.01	Coral	Phylum Cnidaria	Mound, TX; Waschita Formation	Cretaceous
1987.32.01.a-b	Horn coral	Family Aulophyllidae	Mound, TX; Waschita Formation	Cretaceous
1987.32.02.a-o		<i>Zaphrentis</i>	Madison County, AL; Ste. Genevieve limestone	Carboniferous

Table 1. Fossil accessions of the Anniston Museum of Natural History (Ordered by Catalog Number)

1987.32.03.a-b	Horn coral	<i>Caninia</i>	unknown	Carboniferous
1987.32.04	Worm burrows	<i>Serpula dianthus</i>	Mound, TX; Waschita Formation	Cretaceous
1987.32.05.a-b	Bivalve	<i>Lopha</i>	Mound, TX; Waschita Formation	Cretaceous
1987.32.06	Bivalve	Class Bivalvia	Mound, TX; Waschita Formation	Cretaceous
1987.32.07	Bivalve	Superfamily Ostreacea	Mound, TX; Waschita Formation	Cretaceous
1987.32.08.a-b	Blastoid	<i>Peniremites</i>	Madison County, AL; Ste. Genevieve limestone	Carboniferous
1987.32.09.a-c	Bryozoan	<i>Anisotrypa</i>	Madison County, AL; Ste. Genevieve limestone	Carboniferous
1987.32.10.a-b	Brachiopod	<i>Chonetes</i>	Bangor Limestone formation (likely Alabama)	Carboniferous
1987.32.11.a-c	Brachiopod	<i>Spirifer</i>	St. Genevieve Limestone	Carboniferous
1987.32.12.a-b	Brachiopod	<i>Composita</i>	St. Genevieve Limestone	Carboniferous
1987.39.01	Seed fern	<i>Neuropteris decipiens</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.02	Seed fern	<i>Neuropteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.03	Seed fern	<i>Neuropteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.04	Seed fern	<i>Neuropteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.05	Horsetail	Class Sphenopsida	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.06	Seed fern	<i>Neuropteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.07	Seed fern	<i>Neuropteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.08	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.09	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.10	Horsetail	<i>Annularia radiata</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.11	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.12	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.13	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1987.39.14	Fern	<i>Pecopteris</i>	Wilmington, IL; Mazon Creek Shales	Upper Carboniferous
1988.09.01.a-h	Plant impression-compressions	<i>Neuropteris, Alethopteris, Eusphenopteris</i>	Irondale, Jefferson County, AL; Floyd shale	Carboniferous
1988.09.02.a-c	Lycopod	<i>Lepidophylloides</i>	Irondale, Jefferson County, AL; Floyd shale	Carboniferous
1988.09.03.a-f	Calamite stem	<i>Calamitos</i>	Irondale, Jefferson County, AL; Floyd shale	Carboniferous
1988.10.01	Ammonite	Order Ammonitidae	Lowndes County, AL; Selma chalk or Ripley Formation	Late Cretaceous
1988.12.01	Permineralized wood	Division Tracheophyta	Elmore County, AL; Tuscaloosa or Eutaw Formations	Cretaceous
1988.16.01	Coral	<i>Prismatophyllum</i>	Harbor Springs, MI; Bois Blanc Formation	Devonian
1988.16.02	Date seeds	<i>Plantar</i>	Daniel, WY; Wasatch Formation	Tertiary
1988.16.03	Bivalve	Superfamily Nuculanacea	unknown	unknown
1988.16.04	Ammonite	<i>Acanthoceras</i>	Texas	Cretaceous
1988.16.05	Ammonite	<i>Dufrenoyia</i>	Texas	Cretaceous
1988.16.06	Moon snail	Superfamily Naticacea	Daniel, WY; Wasatch Formation	Tertiary
1988.16.08	Worm burrows	<i>Planolites</i>	unknown	Cambrian
1988.16.09	Permineralized wood	Division Tracheophyta	unknown	unknown
1988.16.10	Echinoid test	<i>Holcelypus</i>	unknown	Jurassic/Cretaceous
1988.16.11	Bivalve	Superfamily Limacea	dredged from Miami Harbor, FL	unknown
1988.17.01	Fossilized tooth	Family Equidae	Gilchrist County, FL	Pleistocene
1988.17.02	Femur head	Family Mastodontidae	Suwannee County, FL	Pleistocene
1988.19.01	Turtle shell	<i>Stylernis</i>	Badlands, SD; Brule' Formation, White River Series	Oligocene
1988.19.02	Plant impression-compressions	Classes Lycopsidea and Gymnospermopsida	Durham, GA	Carboniferous
1988.19.03	Bivalve	Superfamily Cardiacea	Lowndes County	Cretaceous

Table 1. Fossil accessions of the Anniston Museum of Natural History (Ordered by Catalog Number)

1988.19.04	Oreodont bones	<i>Mericoidodon culbertsoni</i>	Badlands, SD; Brule' Formation, White River Series	Oligocene
1988.19.05	Fragmented skeleton	Class Mammalia	Nebraska	Oligocene
1988.21.01	Oreodont skull	<i>Mericoidodon</i>	Badlands, SD; Brule' Formation, White River Series	Oligocene
1988.21.02	Fish	Family Clupeidae	Green River, WY; Green river shales	Eocene
1989.13.01	Turtle shell	<i>Stylomis</i>	Badlands, SD; Brule' Formation, White River Series	Oligocene
1990.02.01.bb	Bivalves	Class Bivalvia	Barbour County; Bullock County, AL; Ripley Formation	Cretaceous
1990.04.01	Crinoid stem	Subclass Crinoidea	Key, Cherokee County, AL; Conasagua Formation	Cambrian
1990.15.01	Trace fossil	Indistinguishable	Catoosa County, GA; Sequatchie Formation	Ordovician
1990.15.02	Marine invertebrates	Phylum Brachiopoda; Phylum Bryozoa	Catoosa County, GA; Sequatchie Formation	Ordovician
1990.15.03	Worm burrows	<i>Planolites</i>	Catoosa County, GA; Sequatchie Formation	Ordovician
1992.13.03	Horn coral	Family Endophyllidae	Etowah County, AL; Chickamagua Limestone	Ordovician
1992.13.05	Crinoid stem	Class Crinoidea	unknown	unknown
1992.13.06	Crinoid stem	Class Crinoidea	unknown	unknown
1992.19.06	Permineralized wood	Division Tracheophyta	unknown	unknown
1992.19.07	Permineralized wood	Division Tracheophyta	unknown	unknown
1992.19.08	Palm wood fossil	Family Arecaceae	unknown	unknown
1992.20.01.h	Lycopod	<i>Lepidodendron</i>	Eddyville, Pope County, IL	Tertiary
1992.24.66.a-s	Bivalve	<i>Exogyra</i>	South Central AL	Carboniferous
1992.24.67.a-f	Mammalian vertebrae	Class Mammalia	unknown	Cretaceous
1992.24.68.a-e	Permineralized wood	Division Tracheophyta	unknown	Cenozoic
1993.07.01	Ammonite	Superfamily Acanthorotalacea	Kingslon, Marshall County, OK	Cenozoic
				Cretaceous

THE MILLER STANDARD FOR JUDGING OBSCENITY AT LAW UNDER REAGAN APPOINTED JUDGES¹

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Abstract

Reagan appointed justices on the Supreme Court and judges on the Circuit Courts consistently applied the Miller rule with regard to obscenity except in those cases where they held that the exploitation of children superseded the obscenity issue. Tangentially, the study also found unexpected evidence of judicial activism regarding the Miller rule on the part of some jurists.

During the presidential campaign of 1980 and in his acceptance speech at the Republican National Convention on July 17, 1980, Ronald Reagan included the issue of the federal judiciary as a basic theme. He expressed the belief in the Carter-Reagan debate on October 30, 1980, that over the years the federal courts had become too activist, and interfered too much in the affairs of our citizens. Edwin Meese on November 5, 1980, expressed the belief that Reagan would appoint less activist and more conservative men and women to the federal courts than Reagan, immediately following his election, set about doing. The purpose of this study was to examine how the Supreme Court's standards for judging obscenity at law, using the 1973 *Miller vs. California* (413 U.S. 15) test, has been interpreted by Reagan appointed justices of the United States Supreme Court.

Review of Literature

A study of the U.S. Courts of Appeal found that Democrat judges as a group rated higher on activism, than Republican judges, while Democrat and Republican judges were equally liberal on civil liberties issues (Goldman, 1966). Rowland and Carp (1980) summarized previous studies and found "a tendency for Democratic judges to issue a slightly higher percentage of liberal opinions than their Republican counterparts" (p. 291). This is consistent with the theory that a judge's liberal or conservative behavior is related to political party affiliation. These authors also reported evidence that after 1968, changes in presidential party may have lead to a pattern of increased party related differences among Federal District Courts. A

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subsequent study of presidential effects on criminal justice policy in the lower federal courts (Rowland, Songer, & Carp, 1988) predicted that "Reagan appointed judges on the lower federal courts would be substantially less supportive of criminal defendants" (p. 191) than previous court appointees. This prediction was based on published and broadcast media accounts portraying Reagan as committed to selecting judges with his own ideological leanings. When Rowland, Songer, and & Carp (1988) analyzed each of Presidents Nixon, Carter, and Reagan's appointee's criminal justice decisions, Reagan and Carter judges were at the opposite extremes with regard to support of criminal defendants. Songer and Haire (1992) identified a similar effect regarding obscenity cases for Carter and Reagan appointed judges. Consistent with the presidential effect (Baum, 1992), Carter appointees exhibited unexpectedly high support for criminal defendants that contributed to the extreme polarization of Carter and Reagan appointees (Rowland, Songer, & Carp, 1998).

The Reagan administration used the most systematized screening process for the selection of judges with a like-minded judicial philosophy (Goldman, 1989). One major innovation in the selection process was the interviewing of all leading candidates for judicial positions at the Justice Department in Washington together with the office of Legal Policy. When applicable, a candidate's articles, speeches, and previous judicial writing were carefully scrutinized. The effect of Reagan, who appointed at least 47% of the federal judges, will extend well into the twenty-first century.

To explain the variance in judicial behavior, Gibson (1983) argued for a more complex, partially integrated model that incorporates attitude theory, role theory, small group theory, organization theory and environmental theory to achieve a higher level of explanation of judicial behavior and its prediction. Tate (1981) reported that an examination of seven variables including a judge's political party and appointing president can account for nearly all the variance in a Supreme court justice's voting behavior, at least applied to civil liberties and economic decisions. In labor and antitrust issues, policies enunciated by the U.S. Supreme Court get pushed down to U.S. Circuit Courts whatever the political party affiliation of individual Circuit Court judges, thus showing considerable policy impact on the lower courts by the Supreme Court (Songer, 1987). Regardless of political party association, Biskupic (1991) asserted that in the judicial context, conservative judges strictly construe the Constitution and federal statutes, leaving to the legislature the establishment of new remedies or new remedies while liberal judges do the opposite.

The majority of U.S. District Court judges are strongly tied to their districts and to their local social and political system, through pre-judicial experiences by "birth, residence, training and experience" (Vines, 1964, p. 356). The two southern circuits, the Fourth and Fifth, are more conservative than the remaining circuits, the Fourth and fifth, are more conservative than the remaining circuits (Goldman, 1966). In a study that considered racial desegregation issues, Giles and Walker (1975) found that social background experiences and even local public opinion influence judges.

Songer and Haire (1992) reported that shared experiences of individuals living in the same region of the country affects a judge's judicial attitudes. They found that southern U.S. Circuit court judges were significantly more likely to cast conservative votes than non-southern judges.

In 1973, the United States Supreme Court abandoned the 1957 Roth test (354 U.S. 476, 79 S.Ct. 1304) and approved guidelines for the lawful state regulation of obscene material. Under this new "Miller standard" (413 U.S. 15, 93 S.Ct. 2607) obscene material is not protected as a First Amendment expression of free speech or free press. Such material may be subject to state regulation when under the three-part Miller test, the material taken as whole appeals to prurient interest in sex and portrays, in a patently offensive way, sexual conduct specifically defined by applicable state law, and taken as whole, if does not have serious literary, artistic, political or scientific value, as applied by the average person using contemporary community standards. This Miller definition of obscenity is not a question of fact, but one of law. Later Supreme Court dictums based on the Miller standard have found that only a depiction or description of "hard core" sexual conduct may be judged as being obscene and that Congress may declare it contraband, prohibit its importation, and authorize its seizure by custom officials (*Stanley vs. Georgia* 89 S.Ct. 1243). Indeed much has been adjudicated concerning the meaning of the various parts of the three-part Miller standard. For example in 1982 in *State vs. Barrett* (278 S.Ct. 92), prurient interest was defined as reflective of and arousal of lewd and lascivious desires and thoughts.

Since the 1973 Miller ruling, the Supreme court has delineated between written speech and live performance or film in determining obscenity. Motion pictures are of such a unique nature that they may be judged obscene long before a written description of the matter (*Landau vs. Fording*, 88 S.Ct. 16). Nude entertainment such as dancing is not obscene, although dancing graphically depicting various sex acts in obscene (*Hicks vs. "Sorong Gals"*, 27 Cal App 3d 46).

In their study of integrating alternative approaches to the study of judicial voting, Songer and Haire (1992) hypothesized that U.S. Circuit court judges are expected to treat different types of pornography (i.e., films, magazines, books, pictures) differently in their consideration of obscenity cases. Material that is more explicit and leaves "less to the imagination" (p. 972) would be more likely to be judged obscene and that those materials that might fall into the hands of children also might be likely to be restricted. Their integrated model test found films received less First Amendment protection than less explicit written or textual and that material designed for a juvenile audience received less protection than material designed for adult audiences. In addition, they also found "significant presidential effects" (p. 977) in obscenity cases in Circuit Courts even after controls were added for material differences, legal issues and the nature of litigant status. U.S. Circuit courts were found to rule more in favor of local governments than the federal government in the prosecution of obscenity.

Research Design and Method

Since one would expect conservative judges to uphold local standards and follow existing law, it was hypothesized that Reagan appointed Circuit court judges and Supreme court justices would apply the Miller rule in cases of obscenity and defer to the trial court's decision.

An electronic search was made of all U.S. Supreme court and U.S. Circuit Courts of Appeal cases citing the Miller vs. California case (413 U.S. 15, S.C. 2607) using the *Westlaw* database. Cases which date from 1981 were initially identified. Then Reagan appointed Circuit Court judges and U.S. Supreme Court justices were identified using the *Almanac of the Federal Judiciary*, the *Federal Reporter*, Second Edition and the *Supreme Court Reporter*. All cases that did not involve any Reagan appointed judges or justices were eliminated. The remaining cases were grouped according to one of each of the twelve U.S. Circuit Courts of Appeals or, when applicable, the U.S. Supreme Court. In instances where cases mentioned the Miller citation merely as a footnote, those cases were eliminated and not considered. Only those cases containing the Miller reference in the factual text of the case or in the text of the opinion were included. Of those cases considered, a determination was made pertaining to the application of the Miller standard. The criteria for application of the rule were a discussion of the rule, the application of any of the three prongs of the Miller standard, and a narrow application of the standard by the court. Cases were then classified by type of pornographic material to be judged obscene or not.

Findings and Results

The frequency of citations by Circuit Courts from 1981 ranged from 0 cases (Circuit 1) to 21 (Circuit 9) with an average of 7.5 cases by court. The total number of citations for Circuit courts and the Supreme Court was 112. Frequencies of citations by all courts since 1981, citations by courts with Reagan appointed judges, and frequencies of cases considered by each identified court are presented in Table 1. Because of the variability in the frequencies of citations by all courts and by courts with Reagan appointed judges and the relationship between these Circuit courts and their consideration of the Miller rule cases, correlations between these frequency distributions were performed. The correlation between total citations and citations by Courts with Reagan judges was $r=0.942$ ($p<.001$). The correlation between citations by Courts with Reagan judges and Circuit Courts with Reagan judges considering the Miller Rule was $r=0.875$ ($p.001$) that suggests extremely close agreement between the two frequency distributions and that the findings of this study should be representative of the country.

Miller Standard for Judging Obscenity at Law

Table 1

Citations and Consideration of Miller Rule

Court	Total	Courts with Reagan Judges		
	Citations	Citations	Consideration	Percent
DC	7	5	2	40.0
I	0	0	0	<u>.¹</u>
II	9	3	3	100.0
III	8	5	3	60.0
IV	13	6	5	83.3
V	5	5	3	60.0
VI	4	3	3	100.0
VII	9	9	9	100.0
VIII	7	7	7	100.0
IX	21	10	10	100.0
X	4	3	3	100.0
XI	3	0	0	<u>.¹</u>
Subtotal	90	56	48	85.7 ²
Supreme Ct.	22	22	11	50.0
Total	112	78	59	75.6

¹ Percent not appropriate.

² Percent of citations given consideration

Citations in Circuit courts with Reagan judges ranged from 0 to 10 cases with a mean of 4.7 cases and 62.2% of total citations were in Circuit Courts with sitting Reagan judges. Consideration of cases with citations of the Miller rule with sitting Reagan judges on Circuit Courts ranged from 40% in the DC Court to 100% for 6 of the 12 courts. Two Circuit courts, III and V, considered the Miller standard in 60% for the cases. The Supreme Court considered the Miller rule in 50% of the cases.

Table 2

Application of Miller Rule

<u>Court</u>	<u>Application</u>		<u>Action by Individual Reagan Judges</u>		
	Yes	No	Opinion	Concur	Dissent
DC	1	1	2	2	0
II	3	0	2	1	0
III	1	2	2	1	0
IV	5	0	1	3	1 ¹
V	1	2	1	3	1 ²
VI	3	0	0	5	1 ²
VII	9	0	4	11	4 ²
VIII	6	1	5	3	0
IX	5	5	5	9	1 ¹
X	0	3	1	2	0
Subtotal	34	14	23	40	8
Supreme	9	2	3	22	0
Total	43	16	26	62	8

¹ Dissent on basis other than Miller Rule.

² One judge dissented and concurred, and applied Miller Rule.

In 34 of 48 (70.8%) cases when the Miller rule was considered, the Circuit Courts applied the rule (Table 2). The Supreme Court applied the rule in 9 of 11, approximately 82%, cases. Overall in 73% of the cases, courts with sitting Reagan judges applied the Miller rule if the Miller rule was considered.

Reagan judges wrote 26 of 59 (44%) opinions. Then by inference 56% of the opinions were written by judges appointed by other presidents. For a given court in this study, there may be only one Reagan appointed judge although there were instances of courts with multiple Reagan appointed judges. However, the vast majority of cases were heard by three judge panels. there were 48 instances of Reagan appointed judges concurring or dissenting. In 40 of these cases, Reagan judges concurred with the court's decision, Reagan appointed judges dissented on a basis other than the Miller rule in two cases, and there were at least three cases where Reagan appointed judges both concurred and dissented, and applied the Miller rule.

For the Supreme Court, three opinions were written by Reagan appointed justices. In all instances when a Reagan appointed justice wrote the opinion, Sandra Day O'Connor was the author.

A frequency distribution representing the application of the Miller rule by classification of the type of pornography is provided in Table 3. Pornography cases dealing with children were more prevalent than other types. The application of the Miller standard as to the type of pornography was fairly consistent, except pornography involving children. In at least 69% of the cases where the Miller standard was not applied, children were involved. Indeed, the courts ruled that the exploitation of children superseded any judgement of the obscene nature of the material presented.

Of particular note, is flashes of outright judicial activism from some of President Reagan's most well known conservative appointees. In *Pope vs. Illinois* (107 S.Ct. 1918) Associate Justice Scalia's opinion concurred with regard to an objective or reasonable person test of the serious literary, artistic, political, or scientific value standard "because I think the most faithful assessment of what Miller intended, and because we have not been asked to reconsider Miller in the present case" (p.1923). While clearly writing of his support and application of this aspect of the Miller standard, Justice Scalia concluded his remarks with the comment "All of today's opinions, I suggest, display the need for reexamination of Miller' (p.1923). Apparently justice Scalia was inviting petitioners to ask the Court to reconsider at least one prong of the Miller standard.

Another presumably conservative non-activist Reagan appointed judge is Edith H. Jones, Judge of the Fifth Circuit. In concurring in part and dissenting in part in

Herceg vs. Hustler Magazine, Inc. (814 F. 2D 1017), Judge Jones argued for imposing civil liability for harms caused by the pornography industry. The case was one in which a mother and friend of an adolescent brought suit against a magazine to recover damages for emotional and psychological harm suffered as the result of the adolescent's death, allegedly caused by a Hustler article describing the pleasures of the practice of autoerotic asphyxia. She stated:

Why cannot the state then fashion a remedy to protect its children's lives when they are endangered by suicidal pornography? To deny this possibility, I believe, is to degrade the free market of ideas to a level with the black market for heroin.
(p.1025)

Further she stated "by definition, pornography's appeal is therefore non-cognitive and unrelated to, in fact exactly the opposite of, the transmission of ideas" (p. 1025). She appeared to be digressing from the issues and advocating new legislation from the bench.

Table 3

<u>Consideration of Miller Rule by Type of Pornography Case</u>			
<u>Type</u>	<u>Frequency</u>	<u>Application of Rule</u>	
		<u>Yes</u>	<u>No</u>
Broadcast film	3	2	1
Children	10	1	9
Home movie/personal	1	0	1 ¹
Magazine	8	6	2
Mail	8	8	0
Painting/Photo	3	2	1 ¹
Performance	2	2	0
Print	7	7	0
Telephone(Dial a porn)	4	3	1
Television License	1	1	0
Video Tape	7	7	0
Zoning	3	2	1
Other/Not identified	2	2	1
Total	59	43	16

¹ Involved children

Conclusions

It was posited that Reagan appointed justices on the Supreme Court and judges on the Circuit Courts would apply the Miller standard for adjudicating obscenity cases. One recognized legal precedent, the Miller standard, was isolated, and the application of this rule was investigated by determining if courts with one set of presidential cohort judges and justices cited the standard and if these jurists applied the rule. There was remarkable consistency in the citing of the standard by the courts with sitting Reagan jurists and the application of the standard by these judges with one notable exception in the area of subject type. In the area of child related obscenity, the jurists did not apply the Miller standard based on the premise that the exploitation of children superseded the obscenity issue.

Of the Reagan appointed Justices, Justice Sandra Day O'Connor, the only female on the Supreme Court, wrote all of the majority opinions on obscenity cases. The researcher observed that a number of female Circuit Court judges also wrote opinions on obscenity cases. A new study by jurist's gender of all U.S. Circuit judges' opinions on obscenity and civil liberties cases is indicated.

Evidence in this study was found to indicate that some jurists in question took an activist position on some cases. To learn more about fulfilling presidential appointment expectations, a future study could select a broader spectrum of cases such as criminal justice or anti-trust cases for analysis. Rather than isolate just one legal precedent such as the three-pronged Miller test for obscenity as was done in this study, a wide range of legal precedents such as mal-apportionment (*Baker vs. Carr*, 82 S.Ct. 691), church-state separation (*Engel vs. Vitale*, 82 S.Ct. 1261), or abortion rights (*Roe vs. Wade*, 93 S.Ct. 705) could be selected and analyzed regarding how particular president cohort jurists cited and applied these legal standards.

Additional study of litigant status and case outcomes could be informative. Songer and Haire (1992) found that the nature of litigants was a significant factor in obscenity case outcomes. Comparisons could be made of whether obscenity prosecution originated at the state/local level or federal level. Similarly, comparisons between individuals, private corporations, and governmental organizations such as museums could be informative.

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COVER PHOTOGRAPH: The cover photograph is a view of a mastodon tooth (*Mammut americanum*) that was found in the bed of the Alabama River in Monroe County, Alabama by James Bankston. This species is known to occur in Pleistocene aged deposits. The photograph was taken by George Folkerts of Auburn University using a Nikon 6006 camera.

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A PLEISTOCENE INDIGO SNAKE, *DRYMARCHON CORAIS*,
FROM BOGUE CHITTO CREEK, DALLAS COUNTY, ALABAMA¹

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ABSTRACT

A Pleistocene trunk vertebra (AUMP1108) of an indigo snake, *Drymarchon corais*, of Rancholabrean age was recovered from Bogue Chitto Creek in Dallas County, Alabama. This is the only known fossil record for the species outside of its present range. Records for a recent gopher tortoise, *Gopherus polyphemus*, and abandoned burrows of that species are on about the same latitude as the indigo snake fossil site. Thus, it is likely that the two species co-existed in the Bogue Chitto area during the Pleistocene, and that the indigo snake may have overwintered in tortoise burrows then as they do today.

INTRODUCTION

A Pleistocene trunk vertebra (Auburn University Museum of Paleontology 1108) of an indigo snake, *Drymarchon corais*, was discovered on 22 May 1993 in T 16 N, R 8 E, in the NE 1/4 of Section 19 during the screening of sediments from streambed gravel bars in Bogue Chitto Creek, Dallas County, Alabama. Pleistocene aquatic turtles, a bird, and various Rancholabrean aged mammals have been found in the same deposits in that region (McCarroll and Dobie, 1994) (Figure 1). The location of the study area is shown in relation in Selma, Alabama, where Harper (1943) reported seeing abandoned burrows of gopher tortoises (*Gopherus polyphemus*) (Figure 2).

¹Manuscript received 4 January 1996; accepted 15 March 1996.

MATERIAL AND DESCRIPTION OF THE VERTEBRA

The trunk vertebra (AUMP 1108) consists of three portions: the right two-thirds of the centrum, the left one-third of the centrum, and a portion containing the neural arch and the neural spine, all of which belong to the same vertebra.

In the monotypic genus *Drymarchon*, the trunk vertebrae are distinct among North American snakes in that the entire anterior border of the neural spine is strongly curved anteriorly (see Holman, 1981, Figure 3, p 303) rather than having this border straight, weakly curved, convexo-concave or concave (see Holman, 1981, Figures on pp 297-306). Other important characters of the trunk vertebrae of *Drymarchon* include a neural spine higher than long, a vaulted neural arch, and a well-developed hemal keel. A comparison of AUMP 1108 with the vertebrae from eight skeletons of *Drymarchon corais* in the Michigan State University Museum collections revealed that AUMP 1108 is an anterior trunk vertebra based on the greater development of the neural spines in that region of the column.

DISCUSSION AND CONCLUSIONS

Records of naturally occurring indigo snakes in Alabama are available from only three counties, Mobile, Baldwin, and Covington, all within the lowermost tier (Mount, 1975) (Figure 2). The most recent record was from Covington County (Neill, 1954). "If the indigo snake still occurs in Alabama, it is exceedingly scarce" according to Mount (1975). The extralimital Pleistocene record of *Drymarchon corais* from western Dallas County, Alabama indicates that the species was more widespread in Alabama than realized (Figure 2). In fact, the record lies on about the same latitude in Dallas County, Alabama, as do records for extant indigo snakes in central Georgia (Conant and Collins, 1991, map 161). Nevertheless, this is apparently the first fossil record of *Drymarchon corais* outside of its present range and outside of Florida (Holman, 1995).

Mount (1975) stated, "In northern Florida, southern Georgia, and possible southern Alabama, indigo snakes are found locally in a few desolate areas where gopher tortoise burrows occur in close proximity to stream or swamp-edge habitat. In this area the snakes rely heavily, if not exclusively, on the tortoise burrows for overwintering sites." The localities for gopher tortoises and/or their burrows in Alabama (Figure 2) are east and west of Bogue Chitto Creek but are on about the same latitude as the *Drymarchon corais* fossil site. This may indicate that gopher tortoises were present in the Bogue Chitto Creek area during Rancholabrean times and indigo snakes probably overwintered in the tortoise burrows then as they do today.

ACKNOWLEDGEMENTS

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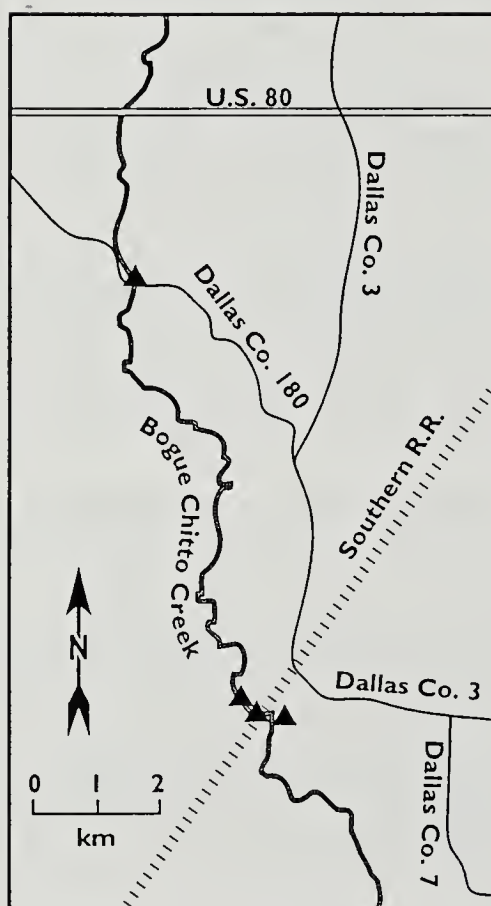


Figure 1. Of the four triangles representing localities from which Pleistocene vertebrates were collected in and along Bogue Chitto Creek, the southeastern most one is the indigo snake site.

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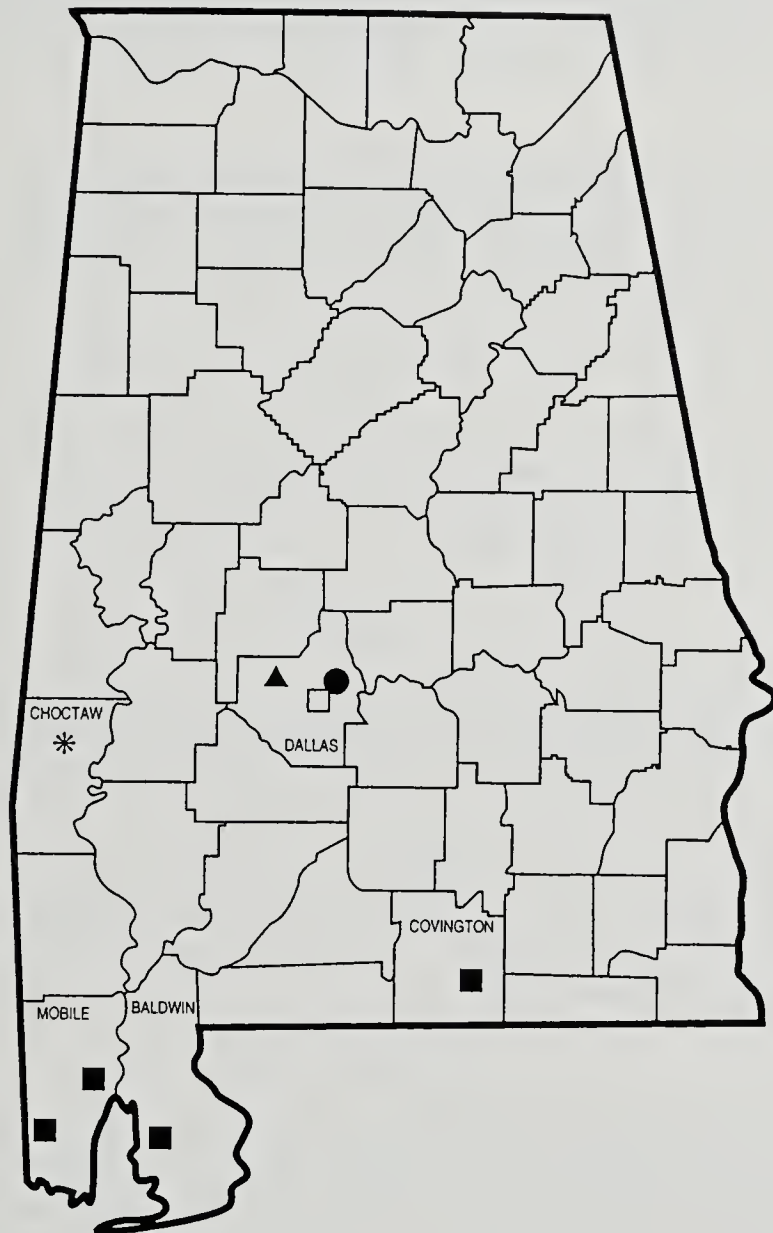


Figure 2. The ▲ is the fossil indigo snake site, the □ is for the city of Selma, the * is a locality for a gopher tortoise, ● is for gopher tortoise burrows, and ■ is for records for extant indigo snakes.

MOVEMENTS OF GRAY BATS (*MYOTIS GRISESCENS*)
BETWEEN ROOST SITES AND FORAGING AREAS¹

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ABSTRACT

Radiotelemetric monitoring was conducted in the vicinity of two inland roost sites in northern Alabama to determine if streams and other waterways were the most common routes taken by adult female gray bats (*Myotis grisescens*) from the inland roost sites to foraging areas on a large reservoir in northern Alabama. Gray bats primarily used tributaries of large waterways as foraging areas and flyway routes to gain access from relatively land-locked roost sites to open-water habitats, but they also flew overland to other tributary systems, which they followed to open-water habitats. Observations of these bats at the same sites at similar hours on different nights indicates that individuals may occupy specific home ranges.

INTRODUCTION

With few exceptions (Hays and Bingham, 1964; Gunier and Elder, 1971; Elder and Gunier, 1978; Timmerman and McDaniel, 1992), the gray bat (*Myotis grisescens*) is restricted to cave habitats (Hall and Wilson, 1966; Barbour and Davis, 1969; Tuttle, 1976a, 1979), which are in proximity to large bodies of water where the bats forage (Tuttle, 1976a, 1976b). Summer colonies use caves that are within 1 km of a large river or lake and rarely are found in caves located >4 km from such places (Tuttle, 1976b). At evening emergence, the bats fly to their feeding area, often forming a continuous stream of bats from the cave entrance to the water's edge. The bats usually fly in the

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forest canopy, occasionally wandering to drink and forage over farm ponds (Tuttle, 1976b). Tuttle (1976b) found that departing gray bats always took a direct route toward a river or reservoir, and La Val et al. (1977) and Thomas (1994) noted that gray bats do not always go to the nearest body of water, but some may fly over land to more distant foraging sites.

Gray bats usually forage over water and in adjacent riparian vegetation up to 70 km from their roosting caves (La Val et al., 1977; Tuttle, 1976a, 1976b; Thomas and Best, in press). These bats primarily feed on flying insects (Tuttle, 1976b; Lacki et al., 1995; T. L. Best et al., in litt.), but few studies of the foraging ecology of gray bats have been conducted. The only detailed studies of gray bats associated with reservoirs were at Norris Reservoir, Tennessee, and at Guntersville Reservoir, Alabama (Rabinowitz, 1978; Thomas and Best, in press; T. L. Best et al., in litt.).

Several colonies of the endangered gray bat (Greenwalt, 1976) are located near impoundments of the Tennessee River and its tributaries in northern Alabama; most of the larger colonies of gray bats (i.e., ≥ 100 individuals) are located within 1 km of impounded water, but two exceptions are Indian Cave, north of Athens, Limestone Co., and Blowing Spring Cave, north of Rogersville, Lauderdale Co. It was expected that gray bats from these and other localities move directly (or nearly so) toward open water to forage, but it was not clear which routes bats from these two caves would take. The objective of the research reported herein was to determine if streams and other waterways were the most common routes taken by gray bats to large reservoirs.

MATERIALS AND METHODS

Radiotelemetric monitoring was conducted in the vicinity of the colonies of gray bats at Indian Cave, Limestone Co., Alabama, located on Sulphur Creek, which flows into the Elk River, a tributary of the Tennessee River, and Blowing Spring Cave, Lauderdale Co., Alabama, located on First Creek, which flows into Wheeler Reservoir (Fig. 1). Using a modified harp trap (Tuttle, 1974), gray bats were captured at Indian Cave and Blowing Spring Cave as they emerged on 19 July and 16 August 1994, respectively. To eliminate differences in behavior between sexes and ages, only adult females (post-lactating) were used in our study. Bats were aged as young-of-the-year or adult. Young-of-the-year were differentiated by the prominent vascularization present at the wrist (Barbour and Davis, 1969; Anthony, 1988). Hair was partially removed from a 1-cm² area on the back with scissors, and a small radiotransmitter (0.8 g, model BD-2A with reed switch, Holohil Systems Ltd., Woodlawn, Ontario, Canada) was attached to 10 adult females at each cave (a total of 20 bats) using non-toxic Skin-Bond cement (Smith and Nephew United, Inc., Largo, FL). Transmission distance for these radiotransmitters is ca. 1-2 km, but may be > 10 km over open water or at monitoring sites with no physical obstructions. These procedures caused no apparent distress to the bats (Thomas and Best, in press).

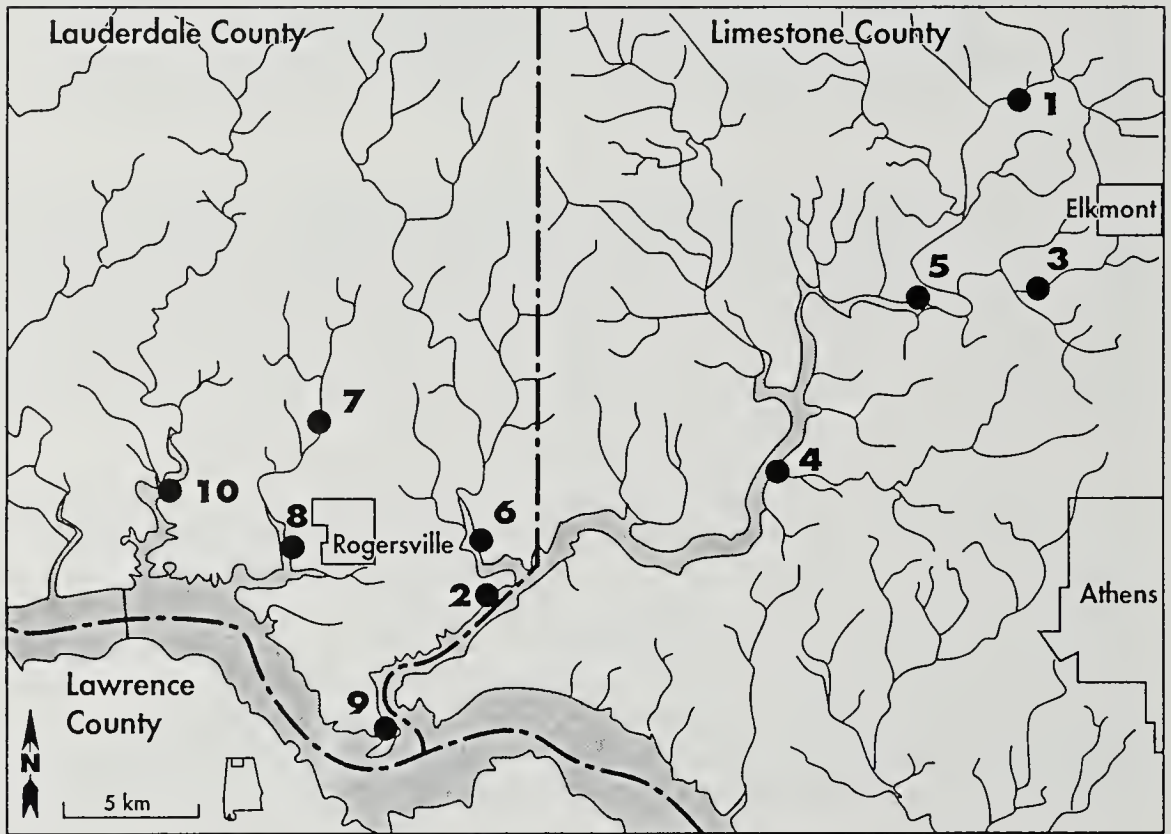


Fig. 1. Sites monitored during a study of flyways used by gray bats (*Myotis grisescens*) in northern Alabama in 1994. Second Creek (site 10), First Creek (sites 7 and 8), and the Elk River (sites 1-5 and 9) flow into Wheeler Reservoir, which is located in the lower-left of the figure. Anderson Creek (site 6) flows into the Elk River. Sites monitored 19-29 July were: 1) Bridge on Elk River, Alabama Highway 127, T1S, R5W, SE 1/4 Section 11, Limestone Co.; 2) Bridge on Elk River, US Highway 72, T3S, R7W, NE 1/4 Section 11, Lauderdale Co.; 3) Indian Cave on Sulphur Creek, T2S, R5W, NW 1/4 Section 1, Limestone Co.; 4) Bridge on Elk River E of Lentzville, T2S, R6W, NE 1/4 Section 25, Limestone Co.; 5) Oxbow in Elk River, T2S, R5W, NE 1/4 Section 4, Limestone Co. Sites monitored 16-26 August were: 6) Boat ramp on Anderson Creek, T2S, R7W, SW 1/4, Section 35, Lauderdale Co.; 7) Blowing Spring Cave, about 5 kilometers N Rogersville, T8S, R4W, NE 1/4 Section 19, Lauderdale Co.; 8) Boat ramp S of bridge on First Creek, US Highway 72, T3S, R7W, NW 1/4 Section 6, Lauderdale Co.; 9) Boat ramp at mouth of Elk River, T3S, R7W, NE 1/4 Section 28, Lauderdale Co.; 10) Boat ramp N of bridge on Second Creek, US Highway 72, T2S, R8W, SW 1/4 Section 27, Lauderdale Co.

Previous experiences in monitoring movements of gray bats by the use of radiotelemetry have shown that these bats regularly fly distances >10 km each night. However, bats with radiotransmitters were detected during only 0.3% of the attempts to locate them by Thomas and Best (in press). To maximize the number of successful attempts to locate bats with radiotransmitters in the present study, we selected monitoring sites that were adjacent to the shortest over-water routes the bats might use to access Wheeler Reservoir on the Tennessee River. In addition, location of each monitoring site allowed us to obtain data from habitats adjacent to streams or rivers. Five teams of two observers each monitored the bats nightly (1945-0600 h CDT) using TRX-2000S radioreceivers (Wildlife Materials, Inc., Carbondale, IL) and collapsible three-element Yagi antennae. The five teams of observers monitored at sites 1-5 during July and at sites 6-10 during August (Fig. 1). Each radiotransmitter frequency usually was monitored on a 1-min rotational basis throughout each night; each minute of monitoring was counted as an attempt to locate a bat. For 10 consecutive nights at each of the two study areas, data recorded during every attempt to locate a bat included names of observers, location, date, frequency monitored, time that monitoring of each frequency began and ended, whether or not a bat was detected, and direction of radiotransmission. These data provided information on when bats with radiotransmitters were active and where they were detected during foraging forays.

RESULTS

Study area at Indian Cave

During 19-29 July 1994, 29,306 attempts were made to locate the 10 bats with radiotransmitters attached at Indian Cave. Of these 10 bats, radiotransmissions were received from nine. One was not located after release. Activity areas of bats generally were over the Elk River, which flows southward into Wheeler Reservoir (Fig. 1). Bats were not detected upstream from Indian Cave (site 3) on the Elk River. Ten nights of monitoring upstream at the Highway 127 bridge (site 1; Fig. 1) did not result in the detection of any bats with radiotransmitters. Thus, all bats were detected in the area between Indian Cave and Wheeler Reservoir. Only two of the bats returned to Indian Cave; one (no. 041) was detected the night it was released, as it moved from the oxbow in the Elk River (site 5; Fig. 1) toward Indian Cave, and the other (841) returned to Indian Cave each night from 22 through 29 July.

Gray bats apparently used the Elk River as a flyway and foraging area. This is substantiated by the detection of a bat (364) west of the oxbow in the Elk River (site 5) at 2138-2201 h, then north of Lentzville (site 4) at 2213-2214 h on 19 July. Another bat (540) was detected west of the oxbow in the Elk River (site 5) at 2151-2156 h, then north of Lentzville (site 4) at 2225-2226 h on 19 July. The same bat (540) was detected at Lentzville (site 4) at 2359-2400 h, then at the Highway 72 bridge (site 2) at 2400-0011 h on 20 July. Another bat (841) was detected north of Lentzville (site 4) at 0117-0238 h, then at the Highway 72 bridge (site 2) at 0312-0313 h on 20 July. The same bat (841)

occurred north of the Highway 72 bridge (site 2) at 2134-2225 h, then at the oxbow in the Elk River (site 5) at 2253-2257 h, then at Indian Cave (site 3) at 2342-2343 h, and then back to the oxbow in the Elk River (site 5) at 2356-0001 h on 22 July. This bat (841) regularly moved between Indian Cave (site 3) and the oxbow in the Elk River (site 5), and on 25 July was detected at the Highway 72 bridge (site 2). Apparently, this bat spent most days roosting at locations other than Indian Cave. On 19 July, one bat (897) moved downstream from Indian Cave (site 3) to the oxbow on the Elk River (site 5), to Lentzville (site 4), and then to the Highway 72 bridge (site 2).

Four bats (170, 540, 841, 897) were detected on two or more occasions at the same monitoring site, indicating that bats may have areas where they regularly forage or pass through (i.e., individual home ranges; Thomas and Best, in press). One bat (170) was present at the Highway 72 bridge (site 2) between 2200 and 0100 h on the nights of 19-22 July, another (540) at Lentzville (site 4) between 2200 and 0100 h 19-21 and 23 July, another (841) at the oxbow in the Elk River (site 5) between 2200 and 0100 h on 22-26 July and between 2000 and 2100 h on 26-28 July, and another (897) at the Highway 72 bridge (site 2) between 2200 and 2400 h on 19 and 21-22 July.

Study area at Blowing Spring Cave

During 16-26 August 1994, 29,244 attempts were made to locate the 10 bats with radiotransmitters attached to them at Blowing Spring Cave (site 7). Of these 10 bats, radiotransmissions were received from five. The remaining five were not located after release. Activity areas of bats were at Blowing Spring Cave (site 7), Anderson Creek (site 6), and the mouth of the Elk River (site 9). Surprisingly, bats were not detected at First (site 8) or Second (site 10) creeks, two tributaries of the Tennessee River, which were the shortest over-water routes to Wheeler Reservoir. Three of the five bats that were detected returned to Blowing Spring Cave (site 7). One (236) was detected there on 18, 21, and 22 August, another (300) in the early morning and the following evening of 25 August, and the other (982) returned to Blowing Spring Cave 19, 20, and 24 August.

Some bats apparently moved to the Elk River via Anderson Creek, then used the Elk River as a flyway and foraging area. This is substantiated by the detection of a bat (081) at Anderson Creek (site 6) and at the mouth of the Elk River (site 9) on the nights of 16 and 18 August. One bat (982) was detected at Anderson Creek (site 6) on 23 August, but only at Blowing Spring Cave (site 7) on the nights of 19, 20, and 24 August. Another bat (236) moved between Blowing Spring Cave (site 7) and the mouth of the Elk River (site 9). Yet another (250) was detected only at the mouth of the Elk River (site 9).

Four bats (081, 236, 250, 982) were detected on two or more nights at the same monitoring site. One (081) was present at Anderson Creek (site 6) between 2000 and 2300 h on the nights of 16 and 18 August and at the mouth of Elk River (site 9) between

2000 and 0520 h on 16, 18, 23, and 24 August. Another bat (236) was present at Blowing Spring Cave (site 7) between 0300 and 0530 h on 18, 21, and 22 August and at the mouth of Elk River (site 9) between 2200 and 0205 h on 16-20 and 22 August, another (250) between 2200 and 0400 h at the mouth of Elk River (site 9) on 17-18 August, and another (982) between 2000 and 2400 h at Blowing Spring Cave (site 7) on 19, 20, and 24 August.

DISCUSSION

Gray bats usually forage over water and adjacent riparian vegetation after emergence from their roost site. Foraging usually occurs below treetop height, sometimes ≤ 2 m (La Val et al., 1977). Some individuals fly directly cross-country, without any distinctive foraging behavior. In most instances, the flight path of bats flying cross-country takes them over water again within a few minutes. La Val et al. (1977) reported that gray bats fly downstream more often than upstream (although several flew upstream), suggesting a preference for the wider downstream sections of streams as opposed to the more narrow, upstream portions. Some gray bats use even the smallest of permanently flowing streams, but most use the larger streams (La Val et al., 1977).

Gray bats are known to move 30-70 km during foraging forays (Tuttle, 1976a; La Val et al., 1977; Thomas and Best, in press), although the usual foraging range of these bats is < 12 km (range 1-35 km; Tuttle, 1976a; La Val et al., 1977). Because of uneven terrain and because the radiotransmitters are small, radioreceivers usually cannot detect signals from distances > 1 -2 km. Thus, at any one time, most (or all) of the bats with radiotransmitters were out of the range of our radioreceivers. In the present study, bats with radiotransmitters were detected during 0.2% of our attempts to locate them. This is similar to a previous study (0.3%) conducted upstream on the Tennessee River at Guntersville Reservoir, Alabama (Thomas and Best, in press).

During July and August, when our radiotelemetry study was conducted, young-of-the-year had become volant and adults did not always return to the cave where they began each night's foraging activity. It appears that gray bats were using alternate roost sites. There was always a monitoring team stationed at the capture site, and while it initially was expected that bats with radiotransmitters would return to these sites on a regular basis, they returned only sporadically or not at all.

In July, we expected gray bats to leave Indian Cave, then go along Sulphur Creek to the Elk River and proceed by the shortest over-water route toward Wheeler Reservoir. This is the movement pattern that actually appeared to be exhibited by the bats. In August, we expected the bats to leave Blowing Spring Cave, then go along First or Second creeks to Wheeler Reservoir (the shortest over-water routes to the reservoir). However, none of the bats were detected at either of these creeks, despite the fact that another colony of this species inhabits a cave on First Creek near Wheeler Reservoir. In late July, female gray bats have completed raising their young, and by mid-August,

Flyways of Gray Bats

they probably have copulated and begun preparation for entry into hibernation. Thus, the bats studied in August had little reason to remain in the vicinity of Blowing Spring Cave. Because the entrance of the cave was monitored each night from 16 through 25 August, we believe the absence of five of the 10 bats indicates that many had moved to alternate roosts or toward their hibernation cave (probably Fern Cave, Jackson Co., Alabama). Because three of the five bats we detected in August were at the mouth of the Elk River, it is possible they traveled overland to the reservoir or that they used other routes along smaller waterways to gain access to the reservoir, but this was not verified.

We must emphasize that all of our monitoring sites (Fig. 1) were on the Elk River, its tributaries, or other tributaries of the Tennessee River (First, Second, and Anderson creeks) and that constant radiocontact was not maintained with each bat. Thus, it is possible that bats moved to areas away from the Elk River and other tributaries to forage; possibly to adjacent woodlands or agricultural fields. However, because of the known affinity of gray bats for open-water habitats (Tuttle, 1976a, 1976b; Thomas and Best, in press), we believe that most of the time bats were out of the range of our radioreceivers they were foraging over Wheeler Reservoir. Because we only detected bats with radiotransmitters over open-water habitats and never over adjacent riparian habitats or nearby woodlands or agricultural fields, we believe that the gray bats we monitored primarily traveled and foraged over open-water habitats. However, we did detect bats at sites that would have required them to fly overland to other tributaries of the Tennessee River, which they then used as flyways to Wheeler Reservoir. Our conclusion that gray bats primarily travel and forage over open-water habitats also is supported by previous research on this species at other reservoirs along the Tennessee River (Tuttle, 1976a, 1976b; Thomas and Best, in press) and by studies conducted in Missouri (La Val et al., 1977).

Previous research also has shown that foraging activities of gray bats seem to be restricted to a home range (Tuttle, 1976a; Thomas and Best, in press). We monitored some bats that returned to the same foraging sites at about the same time on ≥ 2 nights. Although our data are not conclusive, when coupled with similar data from Thomas and Best (in press) and the observations of Tuttle (1976a), there seems to be a strong indication that individual gray bats occupy a specific home range. Perhaps, these bats forage within a relatively well-defined home range where they search for insect prey in a regular manner.

In conclusion, results of our research indicate that gray bats primarily use tributaries of large waterways as foraging areas and flyway routes to gain access from relatively land-locked roost sites to open-water habitats, but they also fly overland to other tributary systems, which they follow to open-water habitats. Future studies are needed to determine if these bats forage over woodlands, agricultural fields, or other areas away from water as they are moving between open-water habitats.

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AN ECONOMIC ANALYSIS OF MUNICIPAL GOVERNMENTAL BUDGETING: THE CASE OF THE BIRMINGHAM, ALABAMA GENERAL FUND¹

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ABSTRACT

Classic public finance studies on municipal governmental budgeting have centered on the budgets of large metropolises. This paper examines these studies of large cities and applies similar analysis to Alabama's largest municipality - Birmingham. The Fiscal Year 1986 was selected because while serving as Financial Officer to the Birmingham City Council, the author was in a unique position to observe and collect information regarding the interactions between the City Council, the Mayor, the Budget Office and the Birmingham Citizenry. Also the author kept extensive records on the budget process for that particular fiscal year. At least three economic phenomena were apparent in the Council's passage of a General Fund budget - incrementalism, non-optimal unanimous agreement and agenda control.

INTRODUCTION & METHODOLOGY

Municipal governments provide general local government services for specific units such as cities, towns, and villages. Birmingham, Alabama is a city large enough to provide an interesting case study, yet small enough to allow an inclusive study. With a population of 264,984 in 1992, Birmingham is the largest city in the State of Alabama and the 63rd largest municipality in the United States. (U. S. Bureau of the Census, 1994)

"Case studies are the preferred research strategy if one wants to learn the details about how something happened and why it may have happened." Case studies combine sources of information. The investigator "must have access to the people involved." In addition, documentation (such as the source documents in producing a budget), participant observation and direct observation are other elements of the case method of research. (O'Sullivan and Rassel, 1995). Using theories on budgeting that have been used in the examination of federal, state and local governmental budgeting practices, this

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case study examines the Birmingham General Fund Budget. Table 1 summarizes the total City budget approved on May 21, 1985. Of these individual budgets, the General Fund is the largest and defines the scope of this paper. The General Fund's revenue comes from the sales and use tax, the occupational tax, and fees from licenses and permits. The General Fund Budget represented the greatest total expenditure (67%) of all the City Budgets.

TABLE 1
CITY OF BIRMINGHAM BUDGET FOR FISCAL YEAR 1986

General Fund	\$127,254,147.39
Airport Operating Fund	\$ 8,119,208.00
Debt Service-Bond Sinking Fund	\$ 13,337,638.61
Community Development Block Grant (An Additional \$5,050,000.00 of CDBG is in the Capital Budget)	\$ 3,360,000.00
Revenue Sharing (An additional \$6,980,710.00 of Revenue Sharing is in the Capital Budget)	\$ 2,100,000.00
Capital Budget	\$ 35,265,727.00
Total of All Budgets	\$189,476,721.00

The next three sections of this article examine the theory and application of three different economic analyses. Following that are some concluding remarks.

INCREMENTALISM: THEORY AND APPLICATION

An incrementalist approach focuses upon the percentage changes for line items between years. (Lynch, 1985; Wildavsky, 1986) The motive for public policy makers employing incrementalism is that "policy analysts have an idea of present conditions, present policies, and present objectives," as a reference point for the future. (Braybrooke & Lindblom, 1963). In governments, line item budgeting has gained wide acceptance and provides the analyst with the base which is completely vital to an incrementalist policy. (Wildavsky, 1986) It takes some time for new programs or line items to have

a base from which to annually start from. After a few years, a base can be developed for a new budget line item and the item becomes entrenched in the incremental process. (Wildavsky, 1986)

Crecine's classic study on the application of the incrementalist model concerned Cleveland, Detroit, and Pittsburgh using data from a portion of the 1960's. (Wildavsky, 1986) These three cities had mayor-council forms of government at the time of the study, with the mayor's office attempted to gain the greatest accuracy possible in revenue estimations, including comparisons with independent, outside estimations. (Crecine, 1969)

On the expenditure side, the executive branch gives "explicit" instruction to the department heads, that reflects any anticipated changes in revenues over the last budget which was passed. The department head first formulates his "regular departmental request," explaining changes in expenditures over a current appropriation. Since department heads may ask for "more than they really need, the mayor's office is expected to cut these requests in order to balance the budget." (Crecine, 1969) To do this, the executive branch determines the expenditures necessary to maintain present programs during the next budget period and makes a comparison to total expected revenues. "If a surplus is indicated, a general salary increase is considered for inclusion in the budget along with increases in various departmental appropriations or special programs of the mayor." The mayor's objective is to put together a proposed budget which is balanced, at least maintains existing service levels, and when possible provides for increases in city employee wages and avoids tax increases. (Crecine, 1969) Having an idea of the mayor's proposed budget, department heads can argue over the department increases or cuts before he presents it to the council. When the Mayor presents his proposal he outlines the local economy, revenue estimates, changes in expenditures from the previous year, and a list of deserving programs or projects that could not be included because of lack of revenue. After the council examines the mayor's proposal, the council tends to approve the mayor's budget "almost exactly as submitted after a series of public hearings where interested parties plead their cases (usually for increased expenditures for some purpose or a decrease or elimination of a tax)." (Crecine, 1969)

The mayor's office is charged with providing a balanced budget. If any change is made in any part of the budget, another part of the budget must be changed in the opposite direction by the same magnitude. The council realizes this, along with the fact, that in Crecine's three city example, approximately 70 percent of the budget goes to pay salaries. Thus, major revisions in salary policies would have to bring about major changes in tax policies. The mayor has staff working in the mayor's office and in the finance department, but "the council has neither the staff nor inclination to undertake such drastic revisions" of the budget. (Crecine, 1969)

In his study of the budgetary process of Oakland, California, Wildavsky found that councillors adamantly disliked cutting personnel. Also the finance department and the city manager endeavor to create a "surplus for unforeseen events." It was clear in Oakland that councillors "do not have time to pay attention to the whole budget." However, if "pet projects" are taken care of, then the rest of the budget "goes by without review." Wildavsky concurs with Crecine's opinion that because of limited time and staff the council "usually rubber stamps" the mayor's or city manager's proposed budget. (Wildavsky, 1986)

Shifting Decisions to Lower Level Bureaucrats

Municipal government department heads are asked to prioritize requests, increments that differ from the current fiscal year being sent up to the policy-makers for review. (Wildavsky, 1986) Thus, "the higher level is merely shifting part of the responsibility for final decision to the lower level," where there are bureaucrats with a "working knowledge" about "the policy outcomes which these expenditures will purchase." (Wildavsky, 1986; Jackson, 1983) "The government can and does act as an interest group" because the government employees who oversee and administer certain programs are a built-in, self-serving interest group, viewing their programs as worthwhile and naturally wanting to maintain their jobs. (Holcombe, 1986)

Lacking time, information and staff, policy-makers rely on the bureaucrats to "propose new programs and to make a case for larger expenditures in old programs." (Niskanen, 1971) Recognizing the lack of profit maximization in government, Niskanen proposes using the natural competition of bureaus to cut down on costs while still increasing services, by allowing bureaucrats to share in any savings gained in the cost of government programs which the bureaucrats presently do not share in. (Ekelund & Hebert, 1983; Niskanen, 1971) Furthermore, he supports the "periodic random reassignment" of review agents because, over time, they tend to become advocates for particular programs. (Niskanen, 1971)

Incrementalists versus Non-Incrementalists

Politicians widely use incrementalism to limit the focus of budgetary decisions, to lessen political differences, and to adapt to revenue and service obligation constraints. Choosing to build on the previous year's balanced budget, incrementalism is adaptable to any balanced budget constraint. Steps necessary to maintain existing service needs can be corrected year by year. (Lindblom, 1959, 1965; Wildavsky, 1986; Schick, 1969)

Often "what is feasible politically is policy only incrementally, or marginally, different from existing policies," (Lindblom, 1968) Politicians who disagree over

ideology can agree more easily on the increments of change in the future funding of present government programs. (Lindblom, 1959) The incrementalist approach is helpful in its tendency to lessen conflict (Schick, 1969) by "reducing the area open to dispute." (Wildavsky, 1986) Incrementalism reduces and simplifies decisions to short-run, pragmatic solutions. (Herber, 1975; Sharkansky, 1972; Wildavsky, 1986) Incrementalism can be thought of as a "rules of thumb" method to find a satisficing solution, defined as a search for an acceptable rather than an ideal solution. (Heiner, 1983; Simon, 1979; Lynch, 1985) Because of "limited knowledge and ability," individuals or groups satisfice because there is lack of "wit" to maximize utility. (Simon, 1955; Jackson, 1983)

A consensus from all the policy-makers is the objective of incrementalist budgeting rather than "some conscious form of pure rationality." (Lee and Johnson, 1977) With no clear public attitudes about the existing budget, incrementalism provides a safe bet, since small changes involve only small risk. (Lindblom, 1959)

With the common practice of line-item budgeting, it is easy to determine increments of change from year to year, allowing the budget office to tell a department "No" on particular items, before a budget is proposed to a city council. (Schick, 1964) The processing of all possible factors of a budget from scratch each year would necessitate "intellectual capacities and sources of information that men simply do not possess." (Lindblom, 1959)

There have been arguments that incrementalism does not produce a thorough examination of the budget, giving too little thought to the question of the government's optimal use of budgetary resources. Schick states that incrementalism employs "fragmented and piece meal tactics," giving a "partial view", a "retrospective bias," a reliance on and acceptance of the "base." (Schick, 1969) LeLoup dislikes the "bias" of incrementalism "against change," with no complete review of the entire budget. LeLoup thinks that annual revenue constraints and existing service constraints are not evidence of incrementalism. (LeLoup, 1978) Both incrementalists and non-incrementalists accept these budget constraints. It is just that incrementalists refer to policy-maker's behavior regarding these constraints as incrementalism.

Although the annual passage of a budget is not the only budgetary decision made, LeLoup points out that "incremental theories focus on annual appropriation decisions." (LeLoup, 1978) Schick thinks that "increments are negotiated in bargains that neglect the outcome" of the particular program in a budget. (Schick, 1969) Incrementalist approaches to budget decisions are plainly motivated by political forces rather than any comprehensive cost-benefit analysis of programs. (Lee and Johnson, 1977)

The desire to achieve optimality is the supposed major difference between incrementalism and what some scholars refer to as the "pure rationality approach." (Lynch, 1979) In a few words, "using the rational model is merely defining one's goals, analyzing the available alternatives, and selecting the alternative that best meets the goals." (Lee and Johnson, 1977) Unlike a purely rational evaluation of a society's present goals, incremental budgeting is a political approach to budgetary decision-making, which outweighs calculations of optimality. Yet proponents of incrementalism espouse the ability of incrementalism to simplify decision-making, smooth over political differences, and to serve as an adequate description of the municipal budgetary process.

Birmingham General Fund

The Alabama State Legislature 1955 Mayor-Council Act, as amended, serves as the City of Birmingham's Constitution. It stipulates that the fiscal year is to run from July 1 to June 30 and mandates that departments must supply the finance director with "estimates of revenue and expenditure" for the coming fiscal year. With the departments and other agencies supplying information to the finance director, one can recognize the situation referred to by Crecine, Wildavsky and Niskanen of relying on input from knowledgeable bureaucrats. During the budget hearings, the different departments and other agencies meet with the Finance Department and representatives from the Mayor's Office and the Council Finance Officer in order to review budget requests. After all the material is in, the Birmingham Mayor submits a balanced General Fund budget and the other budgets outlined in Table 1. In presenting the budgets to the Council, the Mayor delivers his budget message, which focuses on changes from the most recent budgets.

In putting together the Mayor's Proposed General Fund for Fiscal Year 1986, the Mayor and his staff begun with the basic premise that present service levels in the City of Birmingham were to continue. Realizing that experts within each department or agency could better understand the specific needs of their individual department or agency, the Mayor and the Council shifted some of the decisions down to the department or agency level. There is much evidence, as well as a self-admission on the part of the politicians, of using an incremental approach to budgeting when considering the General Fund.

Upon reviewing the Mayor's Proposed Budgets, the Council may make amendments to them. However, any additions to the General Fund must be made up with deletions of equal magnitude in another part of the budget so that proposed expenditures will equal estimated revenues. The Mayor-Council Act precludes the Council from estimating revenues, "except to correct omissions or mathematical errors." (Mayor-Council Act) Therefore, the General Fund revenue estimates are the

responsibility of the Mayor and the Finance Department. The presentation of the General Fund in the Birmingham case is similar to what Crecine, Wildavsky and Lindblom found in their studies, in terms of the proposed budget including comparisons to existing revenues, expenditures and program objectives.

Adoption of the General Fund does not mean that it will not change during the year. Additional appropriations can be made, but require approval by the Council and the Mayor, with the Finance Director certifying that such sources of funds are available. (Mayor-Council Act)

Since the Council relies heavily on the Finance Department and Mayor's Office to sift through information presented in formal budget requests, it would be helpful to focus some attention on the major players in the budgetary process. Aside from the Mayor, there were three other major participants who prepared the Mayor's Proposed General Fund for Fiscal Year 1986. Richard Martin was the City's Finance Director, Leonard Adams was the Budget Director, and Len Gedgoudas was the Mayor's Principal Analyst. Information on how these men decided matters through the budgetary process was provided through direct observation and personal interviews. In formulating the Mayor's Proposed General Fund, much of the reliance on a base revolved around appropriations for personnel. Finance Director Martin, Budget Director Adams, and Principal Analyst Gedgoudas have all stated that much more than half of all the General Fund is made up of personnel appropriations. Lay-offs are rarely contemplated. Martin spoke of a base of services, which most local governments provide. If any funds are available, the City can fund programs beyond that base.

Adams stated that 95% of the appropriations are pre-determined due to continuing programs including some mandated by State Law such as the Transit Service appropriation. Martin, Adams, and Gedgoudas spoke of the existence of fixed costs such as utility expenses. In looking at the various budget requests, Martin explained that budget agents will ask for additions and deletions of the different parts of the appropriations to a department, commission, or agency. The changes are based on changes in publicly provided services. Requests are usually for additions, rather than decreases of appropriations. However, unrequested appropriations can be added to a department, commission, board, or agency due to the fact that there may be another program that the Mayor's Office and Finance Department think is desirable, but that the department, commission, board, or agency budget request did not take into consideration.

Gedgoudas compared the different budget agents as members of one family who are able to give up some of their appropriation in order to help a department that has run into unexpected difficulties. If a department or other budgeted program does not spend

all of its appropriation one year, the department or program is not consciously cut the next year. However, according to Martin, each line item appropriation is based largely on an estimate of what is needed. For the most part, this was determined in the case of Fiscal Year 1986 on the latest available line item appropriation for Fiscal Year 1985 and on the actual expenditures of Fiscal Years 1983 and 1984. Although an estimate is made from information of past years, no formal mathematical relationship is used. Added to the base of continuing existing services are any additional appropriations necessary for new programs. Likewise, subtractions can be made from this base if programs are deleted. Yet even with a reliance on the past spending and appropriation patterns, Martin stated that, "The last thing anyone would want to do is punish a department or other agency for not spending all of its appropriation." Adams pointed out that with quarterly reviews of the budget, the Finance Department and elected representatives are able to guide departments into a conservative use of money by sometimes taking away parts of the different department's appropriations which are deemed unnecessary in light of new information.

As to using a program budget or zero-based system, Martin said that the present organization of the Budget Office printouts could be easily used for a conversion from incrementalism to program, or zero-base, budgeting. To him, program and zero-base are roughly the same thing. Adams, Martin and Gedgoudas stated that incrementalism is used to a degree in their budget preparation. In speaking of how actual budget appropriations are spent on different programs, Gedgoudas and Adams stated that the Mayor relies heavily on the judgment of the department heads. In addition, Adams stated that there was the possibility of mayors sometimes rewarding efficient department heads with salary raises and other benefits. Gedgoudas and Martin were not as certain about efficiency being rewarded.

Of course, the principal player in the formation of the Mayor's Proposed General Fund was Mayor Richard Arrington, Ph.D. In regard to starting out each fiscal year's General Fund with a base to add to, Arrington stated that, "Basically, that is the case." He also spoke of "limited parameters" in the formulation of a proposal for a General Fund because the General Fund could be affected by other City budgets. For example, if federal funds to the City were cut, the Capital Budget would be affected first since so much of the federal revenue tends to go toward projects in that budget. Nevertheless, in trying to re-establish the Capital Budget if such federal cuts occur, the revenues normally put into the General Fund could be affected.

Regarding efficiency, Arrington stated, "It is so important that a person elected by the people be accountable for efficiencies and inefficiencies," though it may not be possible to do so as Niskanen suggested. In addition, since the functions of the City

government will continue whether or not they are efficient, there really is little pressure for efficiency. However, Arrington did express the desire to be able to do more for his outstanding employees than was allowed under the current personnel system, which limits the mayor's freedom to choose his department heads. Currently, the Jefferson County Personnel Board provides the City of Birmingham with lists of certified applicants from which the mayor can choose a department head, but only if there is a vacancy. Otherwise, the mayor is saddled with department heads chosen by previous mayors. This effect is compounded by the mayor being saddled with people chosen by those department heads.

As mentioned earlier, Arrington spoke of a special reliance on the Council President and the Council Finance Chairman in getting the budget passed. At the time of the adoption process for the Fiscal Year 1986 General Fund, David Herring was the Council President and William Bell was the Finance Chairman. An incremental approach is accepted by both since they think that a zero-base budgeting system would result in nearly the same appropriations. Herring stated that the amount of an employee pay raise is decided many weeks before the Mayor's Proposed General Fund is presented. (The Council approved the five percent pay raise for Fiscal Year 1986, publicly submitted by the Mayor's Office.) Bell expressed the view that "Ninety percent of the budget is so basic, and thus virtually predetermined." Both men agreed that it was prudent that decisions of how to spend individual appropriations be shifted down to the experts at the department and agency level. Bell stated he "would like to see further decentralization of decisions outside of City Hall." Yet according to Bell and Herring, major policy decisions would still be made by the politicians. Neither of the two men see any way to ensure efficiency under the present civil service system. As Bell stated, "internal controls are given up to protect the City employee under the civil service system." Bell also thought that City employees should be rewarded by elected officials.

One can note the relationship between the previously discussed theories concerning budgeting and Birmingham's budget process. Starting with the Council's reliance on the Mayor and his City employees to construct a budget, the most memorable quote would likely be that of Martin, "The Council reacts to the Mayor's budget." Crecine found, in his studies, that the mayor was charged with the responsibility of putting together a budget for the council to work with. In developing his Proposed General Fund, the Mayor and his budget staff accepted the idea that a new General Fund builds upon the most recently adopted General Fund, due to the City's continuing obligations. Similarly, Lindblom, Crecine and Wildavsky have acknowledged the existence of a base of appropriations, which will continue operations into the coming year. However, one can note that Lance LeLoup, a critic of incrementalism, also acknowledges the existing service constraints which public administrators face in forming a budget. As stated before, since both incrementalists and non-incrementalists accept the

influence of continuing service obligations in the governmental budgeting process, there is really no need to decide if this particular concept is incrementalist or not. The concept of bureaucrats acting as advocates of their own budgets applies to the Birmingham case. In forming a proposed budget, the Mayor and his budget staff counted on the department and agency heads for input. As Gedgoudas, Martin and Adams have pointed out, the department and agency budget requests are concerned primarily with the continuation of employee salaries and other benefits, as well as standard supplies and service expenses. The shifting down of decision-making to the department and agency levels has been described by Niskanen, Jackson, and Crecine.

Outside of weekly Council meetings, the Council had budget negotiation meetings with representatives of the Mayor's office. The first time was on April 8th, 1985. Between the first and second Council budget meeting on April 29th, the Council Financial Officer produced an analysis of the Mayor's Proposed Fiscal Year 1986 General Fund and Airport Operating Budgets based on a comparison to the latest Fiscal Year 1985 appropriation. At that time, as specifically requested by the Council, a comparison was presented using a percentage analysis with Fiscal Year 1985 appropriations serving as the base. The next morning at the weekly Council meeting, the Mayor gave his formal presentation and speech on the entire Fiscal Year 1986 Mayor's Proposed Budget.

Council President Herring was the only Councillor who attended a meeting in regard to the Capital Budget, since the other Councillors had decided to forward their concerns to Herring. Also at the capital budget meeting were Mayor Arrington, Gedgoudas and the Council Finance Officer. Representatives from the press were only at the April 8th and 29th negotiation meetings, where the whole Council met. Of course the press was also at the weekly council meetings and the Public Budget Hearing.

Council's specific request for an analysis using percentage comparisons between fiscal years was surely evidence of incremental analysis. The Council used Fiscal Year 1985 as a base and focused on large increases in the appropriation for Fiscal Year 1986, with decreases given little attention. For their convenience, the Council Financial Officer suggested that the Council use an expected inflation rate of roughly 4%, based on predictions of the Federal Reserve Board and Congressional Budget Office. Many of the appropriations in the Mayor's Proposed General Fund actually increased by 5%.

Based on Finance Director Martin's interpretation of Article III of the Mayor-Council Act, the Council is restricted from cutting any existing personnel, because the Mayor is in charge of all City personnel outside of the Council Office. According to the Finance Department and Mayor's Office, less than ten people have been laid off in ten years. However, on occasion the City will cut out vacant positions.⁽²⁾ For example, in the Fiscal Year 1986 General Fund, the Mayor proposed and the Council accepted the deletion of one elevator operator position in the Buildings and Inspection Services Department. The Council gives attention to adding personnel to last year's base and

cutting vacant positions. This would naturally lend itself to the Council adopting an incremental approach, because the base appropriation is so entrenched. Similar situations were found in Crecine's studies.

As the Council looked through the General Fund and asked about line items with large percentage changes, explanations were given to the Council by the Council Financial Officer. These large variations indicated policy decisions regarding those programs funded by the various appropriations. The Council realized that there was still the question of how lapsed funds from the Fiscal Year 1985 General Fund would be used. Funds are transferred out of the General Fund on a quarterly basis, with the third and fourth quarter transfers often used in anticipation of budget requests for capital equipment for the next fiscal year. In order to do this, some funds are transferred from Fund 1, the General Fund, to Fund 45, the Capital Improvement Fund. This is what happened to lapsed funds from the Fiscal Year 1985 General Fund. After the different departments made their budget request, including funds for capital outlay, the Budget Office and Mayor's Office made some decisions agreed to by the Council. Seven departments received transferred funds from other parts of the Fiscal Year 1985 General Fund in order for these departments to receive some capital outlay. Five of these seven departments received amounts very close to what their departments had requested. Only the Police Department and Street and Sanitation Departments had requests far greater than the total given by the Fiscal Year 1985 third and fourth quarter transfers, as well as by the Fiscal Year 1986 Adopted Budget appropriations. In the budget hearings it was apparent that Gedgoudas, Martin and Adams felt that those two departments were asking for too much.

After Fiscal Year 1985 was over, a remaining \$1,323,300 was moved from the General Fund (Fund 1), to Fund 45, the Capital Improvement Fund, which is completely distinct from the General Fund. This was necessary since the Mayor-Council Act states that lapsed funds must leave the General Fund at the end of a fiscal year. At the budget meetings, Council had requested another automobile for the Council Office. That vehicle was paid for out of Fund 45 with lapsed funds from the Fiscal Year 1985 General Fund, one of the ways the departmental or agency requests are met.

When looking at the Fiscal Year 1986 Mayor's Proposed General Fund, the Council came up with a number of questions, which the Council Financial Officer then researched and answered. The Mayor's Office, with its administrative authority over every part of City Government, except the Council Office, was able to demand thorough explanations of the Councillors' inquiries. Councillors had twenty-one specific questions concerning different areas of the Mayor's Proposed General Fund.⁽³⁾ The responses ranged anywhere from one-half of a typed page to over twenty typed pages. The Council

asked many other questions, but the answers were relatively short and given verbally by either the Council staff, the Mayor's staff, the Budget Director, or the Finance Director. The Council's budget questions are important because of what they reveal about incrementalism. Council made some departures from an incremental analysis, including a comparison of how a City-run animal shelter program would fare in comparison to the present county-run program, the status of all youth programs and the status of some of the City parks. However, the vast majority of the Council's questions revolved around changes between Fiscal Year 1985 and the proposals for Fiscal Year 1986, and thereby suggest an incremental approach. Examples include information requests concerning personnel additions to the Street and Sanitation and Police Departments. There was also a desire by the Council to get a more in-depth incremental analysis over a five-year period for the Municipal Auditorium and the Art Museum.

Yet as LeLoup pointed out, the approval of annual appropriations is not the only financial decision of governments. The quarterly reviews the Council uses for the General Fund are an example of how the budget process, though most intense on an annual basis, is still a process that continues all year.

In presenting a balanced budget that maintains services and fulfills most of the City's and Mayor's commitments, the Mayor is able to create a situation where the Council cannot expect to make drastic changes. One can recall Lindblom's view that drastic changes from one year to the next are usually not possible. Since personnel are such a big part of the General Fund, Birmingham Councillors were put in a position similar to that found in the studies of both Crecine and Wildavsky.

The Birmingham Councillors needed something to compare a proposal to. The base in this case was the most up-to-date appropriation for Fiscal Year 1985, which is important because as previously stated, appropriations can change during the year. For the purpose of the Council analysis, the appropriations as of April 18, 1985 were used as the base with which to compare the Fiscal Year 1986 Mayor's Proposed General Fund.

For the most part, the Council left the Mayor's Proposed Fiscal Year 1986 General Fund intact. This is not unusual in comparing Birmingham to other cities. Crecine found the same phenomena in Cleveland, Detroit, and Pittsburgh, and Wildavsky in Oakland. Once the Birmingham Council realized that the Fiscal Year 1986 Mayor's Proposed General Fund was close to what had been expected, the Council accepted the proposal with a few amendments. This could be thought of as a satisficing decision. As Council President Herring stated, "We wish to thank the Mayor for giving the Council a good budget proposal to work with."

An Economic Analysis of Municipal Governmental Budgeting

One of the last formal requirements the Council was legally bound to fulfill before passing the City of Birmingham Budget for Fiscal Year 1986 was the holding of a Public Budget Hearing, which took place on the evening of May 14, one week before the Council would pass a budget. The hearing was attended by less than one hundred people with twenty-three of these individuals actually choosing to speak. Most of the people at the hearing were private citizens, either residents or non-resident taxpayers. Also in attendance were people from various organizations funded or requesting funding by the City. The only appropriation change that resulted from the Public Budget Hearing was the increase in the appropriation for the Jefferson County Board of Health Rabies Control. This only happened after the Board had threatened not to continue existing levels of service. All Council appropriation increases are outlined in Table 2.⁽⁴⁾ Reasons for these increases were given in Finance Chairman William Bell's speech, "Council's Response to the Fiscal Year 1986 Budget as Proposed by the Mayor."

TABLE 2
COUNCIL'S SPECIFIC INCREASES TO EXISTING APPROPRIATIONS
AND NEW APPROPRIATIONS TO THE MAYOR'S PROPOSED GENERAL
FUND FOR FISCAL YEAR 1986

Line Item Number	Description	Mayor's Proposal	Council Adopted
2803	Bd. of Education Community Schools	\$436,000.00	\$493,000.00
2841	DART	\$ -0-	\$ 80,000.00
2823	Jefferson Cty. Board of Health Rabies Control	\$450,000.00	\$541,227.00
2859	Arts & Science	NA	\$ 50,000.00
2861	Marketing & Promotion	NA	\$100,000.00
Sloss Furnace Dept. 88	Added 1 Asst. Director	\$253,730.75	\$325,611.15
	Added a restroom facility		

The increases Council made to individual line items in the General Fund totaled to \$570,107.40, leaving the Budget Office to figure out how to re-balance the General Fund. Budget Director Adams knew from which parts of the Mayor's Proposed General Fund he could take money, without significantly altering any City provided services and still being able to fund the special projects the Council added to the General Fund. The two line items with the letters "NA" for Non-Applicable, in the Mayor's Proposed column are marked that way to distinguish them as new line items added by the Council. One temporary proposal made by the Council for the Fiscal Year 1986 General Fund was the cutting of the budget for the Art Museum by \$100,000; this occurred at the second budget meeting. It was predicted by many that the Art Museum appropriation would be restored by the Council before the Fiscal Year 1986 General Fund was passed. This prediction was borne out. The Council Financial Officer instructed the Budget Office to hesitate on the cutting of the Art Museum budget because he saw no need to have the Budget Office determine where to cut \$100,000 out of the Art Museum Budget when the Budget Office was, in all probability, going to have to replace the funds at the last minute. The Council's threat to cut the Art Museum's budget was intended solely to send a message to the Museum to not be so independent of the Council. (The Art Museum had neglected to invite the Council to an Art Museum function.) After the Council thought that the Art Museum understood the message, the Art Museum budget was restored to what the mayor proposed.

In addition Council President Herring requested that the City contract out cleaning services for the new building addition to the City Hall. After a comparison of costs was made and two bids submitted by private firms, the City did indeed contract out these services. It would have taken six city employees at a cost of \$100,480.72 to do the work for one year. Instead the City contracted out the service at a price of \$30,673.68, a savings of \$69,807.24, in addition to the cost of cleaning supplies. With the choice of hiring new employees or contracting out the cleaning service, the City could contract out for the services without displacing any existing employees. This is why such a choice was feasible in light of the elected officials' reluctance to lay off City employees. Saving money through the contracting out of janitorial services is a common practice in U.S. municipalities. (Poole, 1980)

The Birmingham Public Budget Hearing was similar to what Crecine found in his studies. Crecine (1969) noted that at "public hearings, interested parties plead their cases" often "for increased expenditures for some purpose." Due to the Jefferson County Board of Health Rabies Control Program representative making it clear that an increased appropriation was necessary for continued service, the Council gave that program an increase from the Mayor's proposal. A striking similarity between Birmingham and other cities concerns the amount of change the Council implemented on the Mayor's Proposed Fiscal Year 1986 General Fund. As mentioned, Birmingham Council's total changes

An Economic Analysis of Municipal Governmental Budgeting

amounted to \$570,107.40. The Budget Office knew where cuts could be made in other parts of the General Fund so that it would once again be balanced. As mentioned previously, the Fiscal Year 1986 General Fund totaled to \$127,254,147.39. Therefore changes which the Council made amounted to approximately .45% of the total amount of the General Fund. The studies of Crecine and Wildavsky found similar results, with the city councils changing little in the proposed budgets, as long as individual city councillors projects were taken care of.

TABLE 3
STATISTICAL ANALYSIS

Category	Mean	Standard Deviation
Non Departmental:		
<u>FY 1986 with 5% Pay Increase</u> FY 1985 Appropriation as of April 18, 1985	1.0842	.6695
Departmental:		
<u>FY 1986 with 5% Pay Increase</u> FY 1985 Appropriation as of April 18, 1985	1.1126	.1902
All General Fund Items:		
<u>FY 1986 with 5% Pay Increase</u> FY 1985 Appropriation as of April 18, 1985	1.0938	.5543

According to Dempster and Wildavsky, any change between fiscal years of less than 50 per cent would appear intuitively to be incremental. (Dempster and Wildavsky, 1977) The means for appropriation changes for the departmental, non-departmental, and total budget are all well below fifty percent. (see Table 3) Furthermore the mean departmental increase was greater than the mean non-departmental increase. However, standard deviation figures show that the non-departmental increments of change tended to vary more than those of the departmental appropriations. The mean and standard

deviation figures for the total General Fund fell somewhere in between the departmental and non-departmental. A possible reason for the standard deviation being less for the departmental budgets than for non-departmental appropriations could have to do with departmental personnel. Appropriations for personnel constitute a solid base on which to build. Interviews with key players from both the executive and legislative branches revealed the importance of personnel appropriations.

NON-OPTIMAL UNANIMOUS AGREEMENT: THEORY AND APPLICATION

Another striking feature of the observed Birmingham budget process is that as the individual projects of different Councillors are added, there comes a greater chance of unanimity in the approval of the budget. A near-unanimous or actual unanimous voting pattern can be looked at in light of Pareto optimality, a state where all resources of a group are allocated so that welfare or utility is maximized for the group as a whole. (Downs, 1957) When Pareto optimality is reached, no re-distribution of resources can be made to make someone better off without making someone else worse off. (Buchanan, 1962; Herber, 1975; Buchanan, 1962; Due and Friedlaender, 1977) Buchanan argues that one should not expect a Pareto optimal solution under a majority rule setting because those citizens who oppose the wishes of the majority representatives are forced to pay for any legislation that is passed by the "dominant coalition" of majority of the political representatives. (Buchanan, 1962) "The larger the majority required, the more closely would the result approach a Pareto optimum." (Tullock, 1959) Whenever there is a "relaxation of the unanimity rule in the strict sense," and it is replaced by a "rule of relative unanimity or qualified majority (this) involves some cost in efficiency," and loss of Pareto optimality. (Buchanan, 1968)⁽⁵⁾

Yet another view takes into account the motive of increasing the membership of a coalition beyond a bare majority in order to ensure stability. Although supported in an election by a variety of interests, after a politician is elected, each different point of view espoused from supporters vies to be the point of view that actually governs the politician's or his party's official stand on different issues. (Downs, 1957) W. H. Riker has pointed out that if a political group is able to split the benefits of being in power among as small a group as possible, then each member of that group could get the largest share possible so that the smaller a majority is while still maintaining its majority power, the better off each member within the majority coalition would be. (Frohlich, 1975) However, there is some instability in trying to maintain a majority coalition that is just barely large enough to pass legislation, whether it be legislation for a particular law or an entire budget. (Butterworth, 1976) For example Ferejohn's examination of the Congressional Public Works Committee revealed that Congressmen would support projects outside of their district to support members of the same state delegation and to ensure that such projects would continue to be in a federal budget. (Ferejohn, 1974)

Secondly, whether politicians are elected by districts or elected at large, supporting one another's individual projects brings politicians together in their common goal of being able to have special projects. Regarding unanimity, Brian Barry states, "The nearer a system comes to requiring unanimity for decisions, the more prevalent we may expect to find the 'pork barrel' phenomenon." This is because in order to get each member of a political body to agree to a budget requiring unanimous approval, each member of the group will have to be given some special project within the budget. (Ferejohn, 1974) "To guard against the possibility of cycles, the majority coalition incorporates everyone and provides an equal share of the total distribution to everyone," because "there is no difference between the stability of a less than unanimous coalition here and the stability of an economic cartel." (Holcombe, 1986)

The tendency toward unanimity having been established, it can be shown that a unanimous coalition can bring upon a non-optimal agreement because of "the divergence between the private interests of the representatives and the general public interest." (Holcombe, 1986) If a piece of legislation serves a special interest at the expense of everyone else, it would seem that the special interest legislation would be stopped. Yet it is often not stopped because those who would benefit most from the legislation are well-informed, while those who will receive only minimal benefits or be mildly harmed by it are "rationally ignorant." Each representative in a unanimous coalition is allocated a certain amount of support for his special interest projects in return for his support of other representative's "special interest legislation rather than looking out for the general public interest." (Holcombe, 1986) A non-optimal unanimous agreement occurs because a legislator will be in a "prisoner's dilemma" setting in which an individual legislator has an incentive to remain in the majority coalition and thus be in a position to serve the special interest groups that may aid in his re-election, rather than leaving the coalition and losing his share of special interest legislation. When deciding to vote for a single package type of legislation, Holcombe states, "Every representative has the option of joining the majority coalition or not, and every representative benefits from being a member as opposed to not being a member." If members of a legislative body are forced to vote for a package-type piece of legislation when they do not agree with all the contents of that package, "an outcome that is not Pareto optimal is unanimously approved." Therefore a unanimous vote does not guarantee a Pareto Superior move because of the coercive power of a majority coalition. (Holcombe, 1985)

In taking into consideration the rational ignorance effect on the part of the public and the prisoner's dilemma produced by a majority coalition of elected representatives, one can conceive of a unanimously or near-unanimously approved budget being non-optimal. This does not mean that such a budget would have to be non-optimal but that such a budget would have the same possibility of being non-optimal as a budget passed by a simple majority.

Birmingham General Fund

In looking at the case of the Birmingham General Fund one sees that approval comes through voting for or against the entire General Fund. One of the most important concepts concerning the Mayor's Proposed General Fund is the degree of input from the Councillors. Mayor Arrington stated that it is common practice during the year for Councillors to make direct requests of what should be included in the Mayor's Proposed General Fund and in other proposed budgets. These informal negotiations are encouraged so that the budget will come close to being acceptable by all parties involved. Therefore, Mayor Arrington has revealed that many of the items in the Mayor's Proposed General Fund are actually included in order to appease the different Councillors. In return the Mayor's items have a better chance of being approved. At the budget hearings, the Council Finance Officer complied with the request to forward any items that the Council wanted included in the Mayor's proposed budget. As far as efficiency is concerned, Mayor Arrington stated, "It is so important that a person elected by the people be accountable for efficiencies and inefficiencies." Herring and Bell both said that just as the Mayor respects the Council's wishes to include items in a proposed budget and an adopted budget, each Councillor respects the wishes of other Councillors to include their personal wishes regarding appropriations in the General Fund.

The amendments to the Fiscal Year 1986 Mayor's Proposed General Fund can be viewed in light of two other areas of economic analysis. As Niskanen points out, those reviewing a budget tend to become advocates. An example of this is Councillor Germany, who was Chairman of the Transportation and Communications Committee, looking out for the public transit, such as the DART program. Another is Councillor Miglionico wishing to insure the adequacy of funding for the Art Museum. Councillor Miglionico was chairman of the Park and Recreation Committee, which oversees the Art Museum. The Councillors were also respectful to each other's desire to have an input into the adopted budget. Holcombe has spoken of the willingness of elected representatives to support each other's special interest protects and has pointed out that if members of a legislative body are forced to vote for a package type piece of legislation when they do not agree with all of the contents of that package an act that may not be Pareto optimal can be unanimously approved. (Holcombe, 1985) It is uncertain if all the Councillors favored each others' amendments or the entire General Fund, or even the base presented them to work with by the Mayor. Yarbrough was the only Councillor to vote against the budget. All other Councillors secured individually requested additional appropriations in the General Fund. This was even true for the two Councillors absent - Miglionico and Collins.

The Mayor allowed input on the part of the Council, both in the Mayor's Proposed General Fund and in the Adopted General Fund. Likewise, the Council allowed

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individual Councillors to have input into the budget. It is not certain whether the Mayor and the Councillors truly wanted each appropriation that was finally adopted. However, it was demonstrated, in this instance, that in order to get one's own projects included in the Adopted General Fund, elected officials supported other elected officials' projects.

AGENDA CONTROL: THEORY AND APPLICATION

Also there is the question of the budget agenda which the Council has to vote on. In trying to understand the way public issues are decided, public choice economists have developed the median voter model which stipulates that "a majority rule system" tends to "select the outcome most preferred by the median voter." (Holcombe, 1983). The closer a candidate is able to come to selecting a platform that is the same as that of the median voter, the greater the chances of that candidate being elected. In public finance, the output produced takes the form of government goods and services. However, in the agenda control model "the agenda setter has the incentive and the power to manipulate the agenda in order to increase public sector output beyond the level most preferred by the median voter." (Holcombe, 1983)

To begin with, part of the agenda of a fiscal issue is often already set. For instance, when no budget is passed, the government's position falls back to a pre-determined position for such circumstances. "Examples of fall-back positions are zero expenditure and the previous year's expenditure," and termed the "reversion point." (Romer & Rosenthal, 1978 and 1979) The agenda setter is the person who determines what issues will be voted upon. "If the agenda setter were elected in a majority rule setting, then the representative government model would predict that the agenda setter would have been elected under the median voter's most preferred platform." This is because "elected agenda setters are likely to have platforms coincidental with the median voter's preference," because that is the action that would be most likely to result in the reelection of the agenda setter. Yet "agenda setters may respond more to special interest groups than to voters in general" who "are relatively uninformed about issues." The agenda control model does a good job of explaining the empirical results of some situations while the median voter can help explain others. (Holcombe, 1983)

Birmingham General Fund

The Mayor was able to set the agenda since he had a larger, more experienced staff and because he submits a proposed budget. The General Fund is adopted by a simple majority. The Council must adopt a General Fund Budget by the 20th day of June. There is a provision in the Mayor-Council Act that deals with the budget in case the Council fails to pass a General Fund Budget by that time. If a new budget is not adopted in time, the most recently adopted budget (i.e., the previous year's) will be used

until a new budget can be adopted. After the General Fund is passed, it is left up to the Mayor, through the advice of the heads of the different departments and other agencies, how an appropriation may be spent. That is, the Mayor can transfer funds within an agency's or department's individual budget. However, in transferring any General Fund appropriation from one department or agency to another, the Mayor must obtain approval by the Council. (Mayor-Council Act)

The Birmingham Mayor-Council Act's provision for a fall back position if a budget for the General Fund does not pass by June 20 is an example of a reversion point as stated by Romer and Rosenthal. Also a dissatisfied Council could go into the next fiscal year using the last adopted General Fund Budget, but there would still be pressure from the departments and agencies for the Council to go ahead and adopt a new budget. Theoretically, the Mayor could present the Council with a proposed General Fund on May 20, leaving the Council only one month to analyze the budget and make any changes to it within the confines of the Mayor's revenue estimates. In this way, the Mayor is able to set the agenda of what the Council is to react to. If the Mayor wishes, he and the Council could have budget negotiations before the Mayor's Proposed General Fund is formally presented. This could help the Mayor in setting his agenda. Both Bell and Herring acknowledge the position of the Mayor in agenda setting. The vote on the Adopted Fiscal Year 1986 General Fund was nearly unanimous. Councillors Miglionico and Collins were absent and only Councillor Yarbrough voted against the adoption.

The facts concerning agency and departmental budgets bring to mind two ideas. First, the Mayor relies heavily on the heads of the departments and agencies in order to make budgeting decisions regarding the individual departments' and agencies' budgets. Niskanen and Jackson have discussed the reliance on knowledgeable departmental bureaucrats in budget decisions. In addition to relying on his department and agency heads, the Mayor has more control than the Council over the way expenditures are actually spent. This is due to the Mayor-Council Act giving agenda control to the Mayor by not allowing the Council to vote on how expenditures within a department are made.

The analysis the Council uses for the Mayor's Proposed General Fund can be seen in another way. First of all, it is apparent how the Council can become dependent on the Mayor's Office for the budget format. Since the Mayor is given the power to present the budget proposal by the Mayor-Council Act, he has control over the way the budget is presented. When the Council Financial Officer wished to analyze the Mayor's Proposal, computer printouts of the budget from the Budget office were used. Due to the graciousness of the Mayor's Office, in recent times the Council Office has been able to go directly to the Budget Office for information on most matters without going through the Mayor's Office. Yet it must be understood that the Finance Department comes under

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the authority of the Mayor. The agenda control of having only one item to vote for when adopting a General Fund is also a limitation in arriving at an optimal solution. It appears that the Mayor accepted a few amendments after his Proposed General Fund was presented in order to get the vast majority of his proposed budget adopted almost exactly as it was submitted to the Council.

An important factor in the Mayor's control of the agenda is the part-time nature of the Council position. Because Councillors receive part-time pay, they often have a primary occupation outside of City government. Therefore, a part-time Councillor will often be limited to reacting to the proposals of a full-time mayor. Aside from this, the Mayor-Council Act gives the Mayor an important role in the budget process, charging him with the duty of submitting a proposed budget to the Council. The Mayor is at an advantage because the Mayor-Council Act gives the Mayor authority over the Finance Department and every City department or agency aside from the Council office. The Mayor takes the information from the budget hearings to use in the Mayor's Proposed General Fund. Therefore it is the Mayor who deals directly with agencies and departments. The Mayor knows what he wants on the budget and what items are necessary to appease the different Councillors. The Mayor is able to set the agenda. William Bell thinks any Mayor would have an advantage because he has a better knowledge of what is to be presented. However, he also felt that the Council wished for the Mayor to assume such a leadership role. David Herring stated that the Mayor does have the advantage in setting the agenda, since he gives the Council a budget to react to, but that much of the budget includes appropriations previously requested by the different Councillors. Also, if a truly unacceptable budget were presented, David Herring thinks that there is nothing wrong with postponing the budget adoption process until the beginning of a new fiscal year to ensure a satisfactory budget. It appears that the Mayor accepted a few amendments after his Proposed General Fund was presented in order to get the vast majority of his proposed budget adopted almost exactly as it was submitted to the Council.

CONCLUSION

This study has examined the adoption process of the Birmingham General Fund for the Fiscal Year 1986. Focusing on the actions of elected officials, the theories of incrementalism, non-optimal unanimous agreement, and agenda control have been used to explain this process. This study suggests that both the executive and legislative agents responsible for the 1986 budget used an incremental approach through a comparison of the budgets between the latest available Fiscal Year 1985 appropriation and what would be budgeted for Fiscal Year 1986. The incremental analysis served to minimize the individual Councillors' time costs of analyzing the proposed budget, especially in light of the part-time nature of the Councillor position and having a mandated target date

for passage of the budget. Also, an incremental analysis does not question the basic purposes of different programs, so controversy is avoided which further saves time. Non-incrementalists have pointed out that budgeting is more than an annual appropriation process, they emphasize its dynamic aspects. In the case of the Birmingham General Fund this appears to be correct. Both during quarterly reviews and at other times throughout the fiscal year, the General Fund is amended in terms of appropriations and revenue estimates.

There was a reliance of the elected officials and the Finance Department on the different departments and agencies to come up with budget requests. Even the Mayor-Council Act goes a long way towards setting up this relationship. It states that departments and agencies are to submit and discuss proposed individual budgets. Requested increments of change tended to be for increases rather than decreases, which the Mayor and his staff had to decide upon. The municipal government does not have the incentives for efficiency that firms in a perfectly competitive market might have. (The author realizes that a very small percentage of private firms operate in a perfectly competitive market.) Even periodic political elections are no match for the daily tests for efficiency in a perfectly competitive market, consumers are able to "vote" whenever they purchase a good or service. Inefficiently produced goods and services will tend to disappear. However, most people who pay for and consume City goods and services do little to try to influence the production of those goods and services. (Less than 100 people showed up for the public hearing.) The lack of a definitive market mechanism to efficiently allocate government services provides a motivation for the incremental approach. With city officials not having a market to define an equilibrium level of services, the least risky decision would be to continue most appropriations at or near the previous year's real level. Bases which are composed largely of personnel expenditures are rarely reduced, due to the concern for preserving City jobs.

Also, service levels are at least maintained at base levels whether they are needed or not. The few instances where the City contracted out to the private sector would only tend to occur if City workers are not displaced. These personnel constraints, along with the lack of a market for most governmental services, are two important reasons why budgetary changes tend to be incremental.

This study provides an example of how a budget is adopted, with the incentive of getting one's special concerns included in that budget. The Mayor has acknowledged that he attempted to include different Councillors' wishes in his proposed budget. Likewise, the Council as a whole was willing to let the individual Councillors and the Mayor have input into the budget. In the end, the Fiscal Year 1986 General Fund was adopted by a near-unanimous vote. Even if there may have been different items that individual Councillors disliked, and that the Mayor too may have disliked, the Mayor and

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most of the Councillors voted for the budget's adoption. It appeared that the most important matter to the Councillors was getting their own projects in the budget. In fact this was a major topic of discussion at Council budget meetings. Therefore the theory of non-optimal unanimous agreement appears to hold in this case study. Elected representatives approved an overall budget even though it contained individual appropriations they may have disliked because the adopted budget contains special interest items of their own and is voted upon as a "package-type" piece of legislation. One Councillor, who did not seek to amend the budget with a special project, voted against the adoption. This illustrates that joining the majority coalition is a method for guaranteeing that one will receive at least a special project in the budget.

Agenda control was found to be a privilege of the Mayor because the General Fund was adopted on the basis of one package vote, where each Councillor could either vote for or against the entire General Fund put up for adoption. The Mayor can get his budget proposal passed essentially intact by including some Council amendments. The Mayor can include Council concerns even earlier, before he ever submits a proposed budget. In this way, the Mayor is able to set the agenda to which the Council reacts. The Mayor-Council Act gives the Mayor the additional advantage of being able to submit the first proposal and thus also to set the agenda. The ability to control the agenda is enhanced by having the current year's budget as the reversion point or temporary alternative to adopting a new budget.

The theories of incrementalism, non-optimal unanimous agreement, and agenda control have evolved through the observation of many different governmental institutions at the federal, state, and local levels. It may be the nature of the political institution itself, rather than of particular politicians, which sets the stage. The budget process of the Birmingham City government has provided an example in which to observe these three theories in action to some degree. These three theories are related because they act together to reduce bargaining and decision costs through politicians employing incrementalism, politicians supporting each other's projects and the Mayor being able to set the agenda. This does not mean that there is no controversy, but that these three phenomena lessen that controversy. In this way, a General Fund is ultimately adopted by pursuing a satisficing solution.⁽⁶⁾

ENDNOTES

(2) It was pointed out by Councillor Herring that the Council could eliminate a personnel position, department or governmental function through the budgetary process.

(3) A list of those questions and responses can be found in appendix B of Gentle, 1986.

(4) The Councillors and the FY 1986 projects they lobbied for were: Herring, increasing line item 2823 and the budget of the Sloss Furnace Dept.; Bell, increase in line item 2803; Blakenship, inclusion of line item 2861; Germany, line item 2841 increase; Katapodis, inclusion of line item 2859; Miglionico made sure that funds were restored to the Art Dept. after Council temporarily suggested that the Art budget be cut by \$100,000; Myers made sure a mediation program in the Municipal Court was left intact, prior to the Mayor's budget proposal. Also Herring successfully lobbied for an appropriation of \$100,000 from the Revenue Sharing Budget for the Bear Bryant Building at the University of Alabama. Collins successfully lobbied for a \$10,000 appropriation for education regarding the Domestic violence program, also funded from the Revenue Sharing Budget. The Revenue Sharing budget was approved minutes after the General Fund Budget was approved, by the exact same vote. Yarbrough was the only Councillor to vote against the Revenue Sharing Budget, just as he voted against the General Fund Budget. Also, Yarbrough did not ask for any personal spending amendments to the Mayor's proposed budgets.

Steven Weeks was the Council Financial Officer during the passage of the Fiscal Year 1985 General Fund. At the time that General Fund was adopted, there was a Mayor's proposed tax increase voted upon the same day. According to Weeks, in order to get Councillors to agree to a tax increase, special projects from Councillors were included in the adopted budget. All but one Councillor present, Nina Miglionico, voted for the tax increase and adopted a budget. This shows how inclusion of special interest can result in a near-unanimous approval of a tax increase and budget.

(5) To clarify the cost of majority-rules legislation, Knut Wicksell proposes a "bridge" between government expenditures and specific shares of tax revenue to fund those expenditures, with proposals being required to receive unanimous support. (Buchanan, 1967)

(6) For a very detailed explanation of the adoption of the FY 1986 Birmingham General Fund, see Gentle, 1986. Included in that thesis are a more detailed literature review, a verbal and monetary description of individual line items, explanations for large variations in line item appropriations, questions and answers from the public hearing, speeches from the mayor and finance chair, and interviews from the principle players in the budget process. The Master's thesis committee was composed of Dr. Randall Holcombe, Dr. David Whitten and Dr. Francois Melese. Dr. James Buchanan, Economics Nobel Laureate for 1986, stated in a November 14, 1986 letter to Paul Gentle, that the Master's thesis contained "precisely the sort of empirical research that we need much more of." (Dr. Buchanan had been the dissertation chairman for Dr. Holcombe, who was later the thesis chairman for Paul Gentle.) The author would like to thank the anonymous referees, David Herring and Anita Chadha for comments on the preparation of this journal article.

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FIRST RECORDS OF THE PYGMY SHREW, *Sorex hoyi winnemana*
PREBLE (INSECTIVORA: SORICIDAE), IN ALABAMA¹

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INTRODUCTION

The pygmy shrew, *Sorex hoyi winnemana* Preble was once regarded as one of the rarest mammals in the southeastern United States (Diersing, 1980). More recently, considerable information on its distribution, abundance, and habitat associations has become available from Virginia (Handley et al., 1980; Pagels, 1987; Handley, 1991; Pagels et al., 1992; Kalko and Handley, 1993; Mitchell et al., 1993), Kentucky (Caldwell, 1980; Caldwell and Bryan, 1982; Bryan, 1991; Meade, 1992; Kiser and Meade, 1993), Tennessee (Kennedy et al., 1979; Kennedy and Harvey, 1980; Tims et al., 1989; Harvey et al., 1991; Harvey et al., 1992; Feldhamer et al., 1993), North Carolina (Webster, 1987; Laerm et al., 1994; Laerm et al., in press a; Padgett and Rose, 1994), South Carolina (Mengak et al., 1987), and Georgia (Wharton, 1968; Ford et al., 1994; Laerm et al., 1995; Laerm et al., in press). Because the pygmy shrew has been reported from the Cumberland Plateau of Tennessee (Kennedy and Harvey, 1980) and Georgia (Laerm et al., 1995), and because there appear to be areas of appropriate habitat in northeastern Alabama, we undertook surveys specifically for the pygmy shrew. We report here on the results of those surveys.

METHODS

Pitfall surveys were conducted from 22 July to 9 September 1995 at nine sites in Jackson and Dekalb counties, Alabama. At each site, 946-cm³ plastic cups (11-cm lip diameter and 14-cm depth), filled with approximately 0.13 l formalin solution, were

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placed along a linear transect at 10-m intervals below or flush to ground level adjacent to coarse woody debris (i.e., downed logs, stumps, brush) or rock outcrops. Traps were checked at two-week intervals. Standard body measurements (total length, tail length, and hind foot length) in millimeters and gender were recorded from individuals collected, and all specimens were repositied in the mammal collections of the University of Georgia Museum of Natural History.

RESULTS AND DISCUSSION

Our surveys totalled 9,163 trap nights. We recovered five pygmy shrews from two of our nine localities. A male (66-25-9) was recovered on 26 August and a female (61-23-9) and male (73-27-9) on 9 September in the Poplar Springs Wildlife Management Area, 2.0 miles northwest of Skyline, Jackson County. The site at 487 m elevation is characterized by moderately rolling terrain dominated by red maple (*Acer rubrum*), red oak (*Quercus rubrum*), white oak (*Q. alba*), yellow poplar (*Liriodendron tulipifera*), hickory (*Carya*), sassafras (*Sassafras albidum*), and vaccinium (*Vaccinium*). One each (both males, 77-26-9 and 65-25-9) were captured on 3 August and 9 September at Jacobs Mountain Wildlife Management Area, approximately 2.0 miles west-northwest of Skyline, Jackson County along County Road 138, 2.0 miles south County Road 146. This site also at 487 m elevation is characterized by moderately rolling terrain dominated by red oak, chestnut (*Q. montana*), yellow poplar, hickory, sourwood (*Oxygendrum arboreum*), sassafras, and viburnum (*Viburnum*). Additional small mammal species recovered in our trapping effort included 28 *Sorex longirostris*, 10 *Blarina* spp., 1 *Cryptotis parva*, 2 *Peromyscus leucopus* and 1 *Microtus pinetorum*.

The occurrence of *S. hoyi* on the Cumberland Plateau of Georgia, Tennessee, and now Alabama would suggest the species may be distributed further south throughout that physiographic province, or even elsewhere in Alabama. However, additional pitfall efforts in the Talladega National Forest by the senior author in 1993-1994 failed to document the present of *S. hoyi*.

The pygmy shrew is rarely, if ever, a significant component of small mammal communities in which it occurs. No quantitative estimates of density are available from the Southeast. Survey data indicate a capture rate per 100 trap night effort to range from 0.003 to 0.007 in the Blue Ridge of eastern Tennessee (Harvey et al., 1991, 1992), 0.008 in the Upper Piedmont of South Carolina (Mengak et al., 1987), to 0.100 in the Blue Ridge of Georgia (Ford et al., 1994). At Mountain Lake, Giles County, Virginia, Kalko and Handley (1993) indicate the pygmy shrew makes up 0.5% of all small mammals recovered. Pagels et al. (1992) reported *S. hoyi* to make up 4% of small mammals taken in the central Piedmont of Virginia. Similarly, Feldhamer et al. (1993) report it to make up 2.2% of the total small mammals surveyed in the region of Land Between The Lakes in western Kentucky and Tennessee. However, differing trapping methods employed in these studies make comparisons difficult.

First records of the pygmy shrew

The capture rate for *S. hoyi* per 100 trap nights in our study was 0.04. We compared that to capture rate per 100 trap nights of other studies on the Cumberland Plateau of Georgia and in the Blue Ridge of Georgia and North Carolina with exactly similar trapping methods. Laerm and coworkers (1995) report a capture rate of 0.01 *S. hoyi* per 100 trap nights, based upon 9,000 trap nights, in Walker County, Georgia. In the Blue Ridge of Georgia and North Carolina, Laerm and coworkers (in press a) report the capture rate to be 0.08, based upon 137,832 trap nights. Thus, the capture rate in Alabama is about four times that found on the Cumberland Plateau of Georgia, but half that of the Blue Ridge of Georgia and North Carolina. Laerm and coworkers (in press a) suggested that past land-management practices, in particular soil and fire disturbance associated with logging and agriculture, may account for the dramatic difference in densities between the Cumberland Plateau and Blue Ridge in Georgia.

A review of the literature cited above indicates the pygmy shrew occurs in virtually the entire spectrum of forest communities, seral stages, moisture regimes, and elevations throughout the Southeast. It has been reported from oldfield and young clear-cut areas dominated by early successional grasses, early successional stages of pine and mixed pine-hardwood, mixed upland and bottomland hardwood sites, as well as saturated forested wetlands. Substrate and understory associations are also highly varied. Consistent with these observations, Laerm et al. (in press) note that the pygmy shrew has the highest calculated niche-breadth value (described by Sheftel, 1994) of all soricid species in the southern Appalachians. While nowhere is it particularly common, its broad distribution and habitat associations would mediate against concerns regarding its conservation status.

ACKNOWLEDGMENTS

This study was funded in part by the United States Forest Service (Chattahoochee-Oconee National Forest) and the University of Georgia Museum of Natural History. The work of N. Monteith and A. Szymczak was supported by a Provost Student Research Award from the University of Tennessee at Chattanooga. We thank Scott Smallwood and Scotland Talley for assistance in the field. M. Bailey and J. Schrenkel, Alabama Department of Conservation and Natural Resources, and S. Atkins, Tennessee Valley Authority, aided in the search for appropriate habitat.

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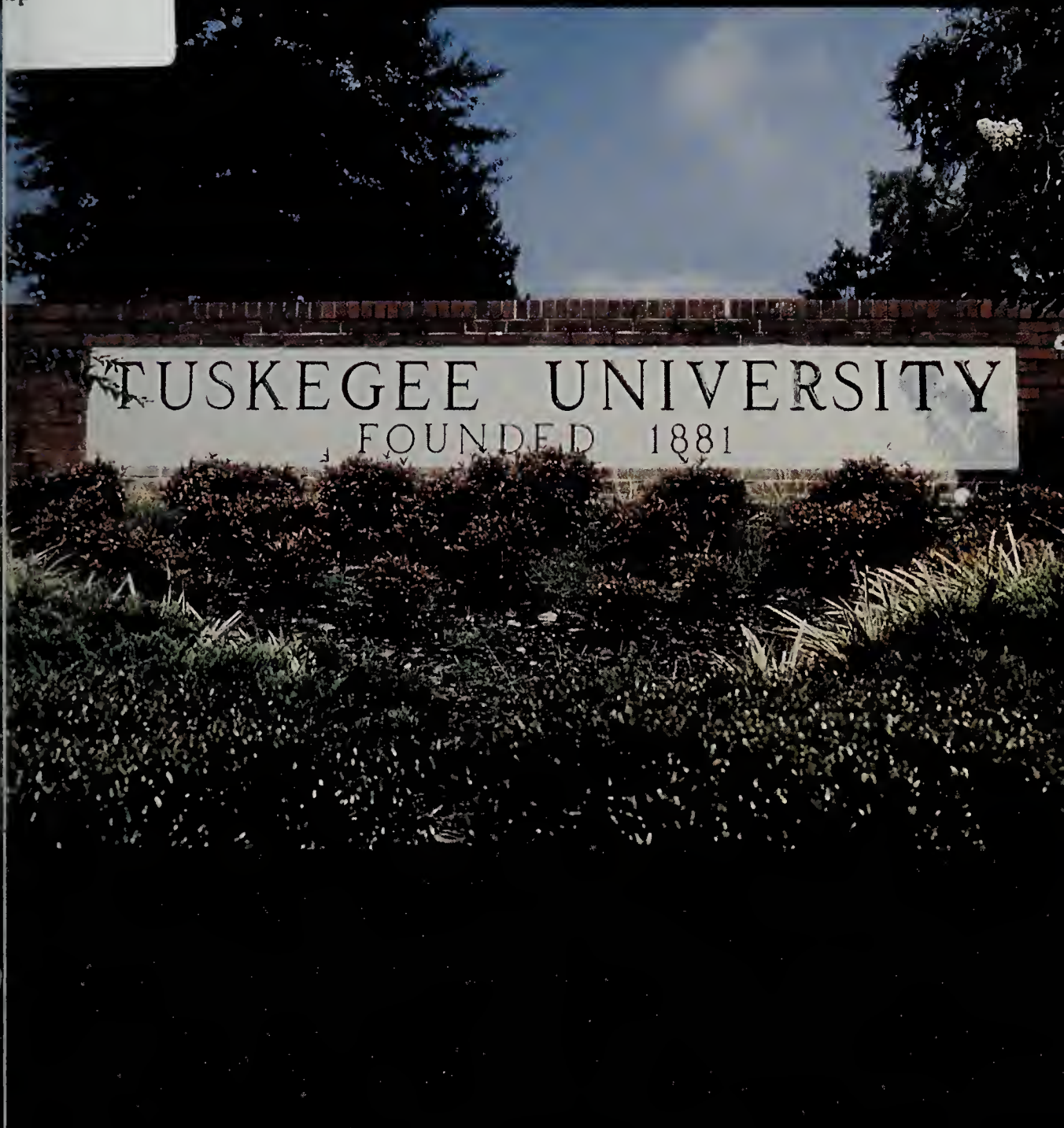
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COVER PHOTOGRAPH: Entrance to Tuskegee University, site of the 73rd Annual Meeting of the Alabama Academy of Science. The photograph was provided by the Office of Information and Public Relations, Tuskegee University, Tuskegee, Alabama.

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ABSTRACTS

Papers presented at the 73rd Annual Meeting
Tuskegee University
Tuskegee, Alabama 36088
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BIOLOGICAL SCIENCES

WOUND RESPONSE IN (BOTRYCHIUM DISSECTUM), THE COMMON GRAPE FERN.
Angela C. Morrow and Roland Dute, Department of Botany and Microbiology, Auburn University, Auburn, AL 36849.

Botrychium dissectum has revealed in some specimens a coating which covers the pit membrane, torus, and sometimes lines the tracheid lumen. The occurrence of such coatings has been associated with wound response in other woods. Laboratory-induced wounding of Botrychium plants was accomplished by removing the leaf, roots, and periderm from the rhizome and longitudinally splitting the rhizome. One half of the rhizome was fixed as the control and the other half placed on moist filter paper in a sealed petri dish. Samples were harvested at day four, six, fourteen and twenty and prepared for TEM observation. In addition, a specimen set was placed on filter paper saturated with an ethylene inhibitor in a sealed petri dish in order to test the involvement of ethylene in the process. Field-induced wounding was performed by removing the leaf and fertile spike down to one half centimeter above the soil surface. The field samples were also collected over four collecting dates and prepared for TEM study. Preliminary observations indicate that wounding produces the observed coating. The coating material efficiently blocks the pit membranes and might provide a barrier to pathogens. This work was supported in part by the Alabama Academy of Science.

ORIGINS OF THE NON-INDIGENOUS FLORA OF CONECUH COUNTY, ALABAMA.
Alvin R. Diamond Jr., Troy State University Arboretum, Troy State University, AL 36082.

Of the 984 species of vascular plants documented to occur in Conecuh County, 136 species or 14% are non-indigenous. Of these 136 species, 34 or 25% have their origins in Asia. Thirty species or 22% have their origins in Central or South America. Twenty-five species each have their origins in Europe and Eurasia. Seven species have their origins in other regions of Alabama or the continental United States. Four species were native to Africa. Three species are described as Pantropical. Two species are native to the Old World tropics and one species is native to the Mediterranean regions of Europe and North Africa.

CILIARY PATTERNS OF HYALOPHYSA SPP., A SYMBIONT OF PALAEMONETES PUGIO FROM COASTAL ALABAMA. Stephen C. Landers, Tom Coate, and Michael A. Zimlich, Department of Biology, Troy State University, Troy, AL 36082.

The genus Hyalophysa is a ubiquitous protozoan associated with crustacea. Hyalophysa is a ciliate (Order Apostomatida) that feeds on the exuvial fluid of its crustacean host after ecdysis. The majority of the life cycle is spent encysted on its host waiting for its time to feed, and after feeding the ciliates settle on the substrate where they produce daughter cells that can infest more crustaceans. This study involves Hyalophysa isolated from the host shrimp, Palaemonetes pugio. Shrimp are maintained in aquaria at the TSU campus and examined upon molting. The feeding stage of the ciliate possesses the diagnostic features upon which species identification is made following silver staining. Our results show that Hyalophysa spp. isolated from P. pugio from coastal Alabama differ significantly from Hyalophysa chattoni, which is found on P. pugio in North Carolina. Specifically, the morphology of the anterior ventral field of kinetosomes (AVF, a scattered field of cilia located on the anterior ventral surface of the trophont) possesses a double row of kinetosomes extending from the AVF to the lower right between kineties 1 and 9. Additionally, the AVF possesses more scattered groups of kinetosomes than is typically found in H. chattoni. This morphological variant is found in the majority of the cells examined by silver staining (>80%). A similar Hyalophysa variant was reported from P. pugio in North Carolina as a rare occurrence. These initial findings indicate that both the H. chattoni typical morphology and the alternate morphology are found in Alabama and North Carolina, though the prevalence of each form on P. pugio is different at the two locations. A study of apostomes from various crustacea from the Gulf of Mexico is in progress to help better understand the distribution of the group.

CHEMORECEPTIVE RESPONSES OF MITRELLA OCELLATA (MOLLUSCA: GASTROPODA) AND OPHIONEREIS RETICULATA (ECHINODERMATA: OPHIUROIDEA) TO A BERMUDIAN ASTEROID, COSCINASTERIAS TENUISPINA (ECHINODERMATA). Daniel P. Swenson and James B. McClintock, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

The gastropod Mitrella ocellata and the ophiuroid Ophionereis reticulata were tested for avoidance and escape responses to the asteroid Coscinasterias tenuispina. Gastropods and ophiuroids were subjected to asteroid odor (avoidance) and asteroid tube-foot contact (escape). The gastropod M. ocellata reduced speed and changed direction of movement when exposed to both asteroid odor and tube-foot contact. However, M. ocellata did not respond to asteroid odor with stereotypical gastropod avoidance or escape behaviors. The ophiuroid O. reticulata did not respond significantly to asteroid odor, but showed a strong escape response to asteroid tube-foot contact, recoiling contacted arm-tips and moving rapidly away. The presence of an escape response in O. reticulata is supported by its habitat overlap with C. tenuispina and by the proposed foraging strategy of this asteroid. This study was supported in part by a Bermuda Biological Station for Research, Inc. Graduate Fellowship to D. P. S. and an NSF EPSCOR Grant (#EHR 9108761) to J. B. M.

Abstracts

PHOTOSYNTHETIC RESPONSE TO LONG-TERM AND SHORT-TERM CHANGES IN CARBON DIOXIDE IN SWEETPOTATOES GROWN HYDROPONICALLY WITH ENHANCED MINERAL NUTRITION.

Casey Johnson, Douglas R. Hileman, Desmond G. Mortley and Jill Hill, Dept. of Biology and Dept. of Agricultural Sciences, Tuskegee Univ., Tuskegee, AL 36088.

Sweetpotato [*Ipomoea batatas* L.(Lam)] has been selected by NASA as a potential food for long-term space missions. In previous experiments, sweetpotato plants grown hydroponically under elevated levels of CO₂ depleted the nitrogen in the nutrient solution between the bi-monthly solution replacements. In this experiment, the effect of enhanced nutrient replenishment on photosynthetic rates of sweetpotato was determined. CO₂ response curves were determined for 'TI-155' and 'Georgia-Jet' sweetpotatoes grown hydroponically in growth chambers at three different CO₂ concentrations (400, 750, and 1000 $\mu\text{mol mol}^{-1}$ CO₂). Gas exchange measurements were made using infrared gas analysis, an open-flow gas exchange system, and a controlled-climate cuvette. Photosynthetic measurements were made at CO₂ concentrations from 50-1000 $\mu\text{mol mol}^{-1}$ CO₂. Net photosynthetic rates showed an increase with increasing measurement CO₂ in all nutrient regimes, but the response of photosynthetic rates to the growth CO₂ conditions varied among the experiments and between the two varieties. Net photosynthetic rates tended to increase with enhanced nutrient replenishment, but the increase was not consistent. The results of this study will help to determine the CO₂ requirements for growth of sweetpotato in the proposed space station. (Supported by NASA.)

DOES NICKEL HYPERACCUMULATION CORRELATE WITH NICKEL

TOLERANCE? Michael A. Wall, Robert S. Boyd, and James E. Watkins, Jr., Dept. of Botany and Microbiology, Auburn University, AL, 36849-5407.

Nickel hyperaccumulating plants contain greater than 1000 ppm dry weight Ni when grown on serpentine soils. Though hyperaccumulating plants have received much attention for potential uses in geochemical exploration and phytoextraction, its ecological significance has received little consideration. This study tested the hypothesis that one function of Ni hyperaccumulation is increased Ni tolerance. We determined the Ni tolerances of three species: *Streptanthus polygaloides* (a Ni hyperaccumulator endemic to serpentine soils), *Streptanthus breweri* (a non-hyperaccumulating serpentine endemic), and *Brassica oleracea* (a non-serpentine crop species). Nickel tolerance was assessed by comparing root elongation of germinating seeds across treatments of varying Ni concentrations (0-100 ppm Ni). All species showed significant inhibition of root elongation at the lowest concentration (5 ppm Ni). However, each species reached maximum inhibition at different Ni concentrations. Maximum inhibition occurred at 10 ppm for *B. oleracea*, 30 ppm for *S. breweri*, and 50 ppm for *S. polygaloides*. These results are consistent with the hypothesis that Ni hyperaccumulation is a Ni tolerance mechanism for plants growing on serpentine soils.

Abstracts

WOOD RESPONSE TO INVASION BY ASIAN AMBROSIA BEETLES AND THEIR FUNGAL ALLIES. Michael A. Davis and Roland R. Dute, Dept. of Botany and Microbiology, Auburn University, AL 36849.

In recent years the incidence of attacks on orchard trees by Asian ambrosia beetles, *Xylosandrus crassiusculus*, has increased dramatically. These beetles attack a wide range of tree species in early spring. The insects bore tunnels into the tree trunks and introduce a fungus which is grown to feed their larvae. This fungus, the ambrosia fungus (*Ambrosiella* spp.), is generally not pathogenic, but it is not unusual for the beetles also to introduce secondary, possibly pathogenic, fungi such as *Fusarium* and *Ceratocystis*. It is commonly thought that decline and death of invaded trees result from mechanical damage received during tunneling. This study was designed to use transmission electron microscopy and scanning electron microscopy to investigate wood response of two different tree species to beetle attack and fungal infestation. The two species were *Prunus x yedoensis*, Yoshino cherry, and *Cercis canadensis*, eastern redbud. Cherries and redbuds that had not been attacked were used as controls. Infected trees had the cell lumens of the water-conducting cells (vessel members) occluded by gums. There was also an absence of starch grains in ray cells of fungus-infected wood. Macroscopically, trees wilted and died back to the point of invasion. Fungal growth was not restricted to the insect galleries; rather hyphae grew vertically through the vessel members via perforation plates and horizontally through vessel members and ray cells via pits. The fungus possibly was utilizing starch reserves in the ray cells as a food source. It was concluded that decline and death of these trees was due to blockage of vessel member lumens by deposition of gums and by the presence of large numbers of fungal hyphae.

THE CYRILLA RACEME COMMUNITY. Debbie R. Folkerts and Roland R. Dute, Dept. of Botany & Microbiology, Auburn University, AL 36849-5407.

Inflorescences of *Cyrilla racemiflora* L. (Cyrillaceae) were investigated with a community perspective and on a descendinglv small scale. Plant and associated animal specimens were collected from a small, artificial population in the Davis Arboretum on the Auburn University campus. Flower visiting insects were collected with aerial nets and with tacky-trap strings. Over 25 insect families were observed, including herbivores, predators and parasites. The most common species, by abundance and frequency, was a Halictid bee, assumed to be the primary pollinator. Foreign pollen observed on stigmatic surfaces and on *Cyrilla*-visiting honey bees indicated that pollinators are promiscuous in this setting. Scanning electron microscopy revealed unusual features of flower morphology as well as invasion by fungal hyphae and cutinolytic bacteria. The phenomena revealed in this preliminary investigation warrant further study.

EFFECTS OF ELEVATED CO₂ ON CYTOCHEMISTRY, ANATOMY, AND ULTRASTRUCTURE OF LONGLEAF PINE (*PINUS PALUSTRIS*) FOLIAGE GROWN UNDER RESOURCE LIMITATIONS. Seth G. Pritchard and Curt M. Peterson, Dept. of Botany and Microbiology, Auburn University, AL 36849.

The response of forest species to increasing atmospheric carbon dioxide, particularly under resource limitations, will require further study in order to predict probable changes which may occur at the plant, community and ecosystem level. Longleaf pine (*Pinus palustris* Mill.) was grown for 20 months at two levels of carbon dioxide, 360 and 720 ppm (parts per million) under two levels of soil nitrogen (4 gr m⁻² y⁻¹ and 40 gr m⁻² y⁻¹) and two levels of soil moisture. Water-stressed plants were allowed to dry to predawn xylem potential of -1.5 MPa and well-watered plants were maintained between 0 and -0.6 MPa. Leaf tissue was collected in the spring and fall and was examined using transmission electron microscopy (TEM) and light microscopy. Electron micrographs showed that during early spring, the accumulation of leaf starch disrupts the internal organization of mesophyll chloroplasts which is most pronounced under conditions of low nitrogen and water stress. During the fall harvest, needles contained very little starch. However, chloroplasts from the elevated CO₂ treatments exhibited symptoms typical of frost hardened conifer needles including coagulated vacuolar tannin deposits, increased numbers of plastoglobuli, and shorter grana. An interaction of elevated CO₂ with the frost hardening process is suspected. Elevated CO₂ had no significant effect on either phloem anatomy or ultrastructure, however a trend toward lower needle phloem cross sectional area was observed. These results suggest that, in nature, longleaf pine may be sink limited under future elevated levels of atmospheric carbon dioxide.

APIOS AMERICANA MEDIKUS (FABACEAE): AN INFRASPECIFIC REVISION. Michael Woods, Department of Biological Sciences, Troy State University, Troy, AL 36082.

The genus Apios Fabricius is a member of the subtribe Erythrinae, tribe Phaseoleae, subfamily Papilionoideae of the family Fabaceae. Apios americana Medikus is an herbaceous, twining vine from a perennial rhizome that occurs in eastern North America from southern Florida north to Nova Scotia west through southern Canada to southeastern Manitoba, southwest to eastern Colorado and south to southern Texas. A. americana was first described by Cornut in 1633. Prior to this taxonomic revision, A. americana was regarded as consisting of six infraspecific taxa. The species herein is considered not to include any infraspecific taxa. This conservative species concept allows for the expected morphological variation of a species within its overall range.

Abstracts

ENVIRONMENTAL ALTERATIONS OF CRAYFISH PIGMENTATION. Mickie L. Powell and Stephen A. Watts, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, AL 35294-1170.

Cryptically-colored animals blend in with their environment and increase their chances of survival by decreasing their risk of predation. Some animals can adapt rapidly to changing environmental conditions; other animals have evolved with their environment over time so that they are camouflaged in their surroundings. Similarly, crayfish have evolved cryptic coloration in their carapace to conceal them in their stream or pond habitats. Carapace color in crayfish is influenced by genetics and diet, however, the extent to which coloration can be controlled by the crayfish is not well documented. Crayfish were placed into black containers, white containers and white containers without light to determine the ability of the crayfish to alter its carapace color based on environmental conditions. All crayfish were fed a formulated diet and held at 28°C. After three weeks crayfish in black containers were distinctly darker than those in white containers or those held in the dark. Animals held in white containers in the dark showed no significant color changes from those held in white containers in the light. Crayfish were moved from black to white containers and from white to black containers after three weeks and from dark to light conditions. Crayfish began acclimating to the color of their new container after the first molt. However, molting was necessary before any carapace color change was observed. The preliminary results from these experiments indicate that crayfish have a limited ability to alter their color based on their environment.

GENETIC DIVERSITY OF THE ENDANGERED ENDEMICIC PLANT, *CLEMATIS SOCIALIS* KRAL. James E. Watkins, Jr., Margaret T. Erskine, and Robert S. Boyd, Auburn Univ., Department of Botany and Microbiology, Auburn, AL 36830

Clematis socialis Kral is a federally endangered plant known from only two Alabama counties. This study was conducted to determine and compare the levels of genetic diversity within the narrow endemic *C. socialis* and the widespread *C. crispa* L. Starch gel electrophoresis was conducted on leaves collected from two populations of each species. Genetic diversity was determined by isozyme analysis of band phenotypes. Twenty enzyme systems were examined initially, of which seven were able to be scored: glutamate dehydrogenase (GDH), malic enzyme (ME), shikimate dehydrogenase (SKDH), catalase (CAT), isocitrate dehydrogenase (IDH), malate dehydrogenase (MDH), and glucose-6-phosphate dehydrogenase (G6PDH). Electrophoretic data from these seven loci, using approximately 20 plants from each population, indicated moderate levels of diversity both within and among populations. The data from this study show that *C. socialis* was fairly diverse for a narrow endemic, yet less diverse than the widespread *C. crispa*.

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A PRELIMINARY SURVEY OF DIGESTIVE ENZYMES IN JUVENILE RED SWAMP CRAYFISH, PROCAMBARUS CLARKII. Hugh S. Hammer, Charles D. Bishop, and Stephen A. Watts, The University of Alabama at Birmingham, Birmingham, AL 35294-1170.

Crayfish are the most extensively cultured crustacean in the United States, responsible for nearly 100 million dollars in annual revenue in Louisiana alone. Crayfish consume a wide variety of organisms, however, the digestive physiology in juvenile crayfish is poorly understood. Juvenile crayfish were raised in closed systems with aeration at 25°C and fed a formulated diet shown previously to promote maximal growth. Individuals of increasing wet weight (12-141 mg) were assayed for the presence of the digestive enzymes trypsin, α -amylase and lipase. The specific activities (per mg wet weight) were determined using appropriate spectrophotometric and fluorometric assays. Preliminary results suggest that all three enzymes were present displaying highly variable specific activities in crayfish of low total wet weight. We hypothesize that this variability is due to differences in molt stages among the individuals assayed. In addition, recently hatched individuals had the highest specific activities in all of the enzymes examined; these specific activities decreased as individuals increased in size. Lipase exhibited the highest average specific activity, converting 0.584 ($\pm$ 0.0443) micromoles of 4-Nitrophenol caproate per minute; α -amylase liberated 0.203 ($\pm$ 0.0187) micromoles of maltose from starch per minute; while the average specific activity of trypsin was 349.99 ($\pm$ 22.47) BAEE units per minute. The results of this study may have implications for the production of better formulated feeds for crayfish during early development.

RECENT ICTHYOFAUNAL DIVERSITIES ON THE UPPER CAHABA RIVER: POSSIBLE EFFECTS OF URBANIZATION. Dave Onorato, Robert Angus, Melinda Lalor, and Ken R. Marion, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

During the fall of 1995, 15 sites in the upper Cahaba watershed were sampled as part of an ichthyofaunal survey. Initial data were analyzed with an Index of Biotic Integrity, a Jaccard Index of community similarity, and the percent relative abundance of various taxons. These indices indicate that areas of the upper Cahaba around Birmingham have experienced declines in ichthyofaunal diversity compared to recent historical data. The decline of several "pollutant intolerant" species at several sampling sites was also noted. These reductions are likely due to the continued discharge of large concentrations of nutrients into the river, along with ongoing development and construction along its banks.

BIOCONVERSION OF CHOLESTEROL BY THE GONADAL TISSUES OF THE ECHINOID *LYTECHINUS VARIEGATUS*? Kristina M. Wasson and Stephen A. Watts. University of Alabama at Birmingham, Birmingham, AL 35294-1170

In August 1995 and again, in February 1996 *Lytechinus variegatus* were collected from Saint Joseph Bay, Florida and transported to the University of Alabama at Birmingham. Echinoids were dissected and gonads were removed. Gonadal tissues were prepared by (1) homogenizing tissues in 20 mM HEPES buffer (pH 7.4) for final homogenate concentration 20% (August) or (2) mincing tissues (February). Homogenates and minces were incubated in media containing radiolabeled cholesterol (1 μ Ci/ ml media), 20 mM HEPES, 3% propylene glycol, 1 mM NADPH (pH 7.4, 32 ppt). Incubations were terminated at 0.5, 2, and 8 h with 3 volumes methylene chloride (MC) and extracted with 3 x 3 volumes MC. Organic-soluble portions of extracts were pooled and dried under stream of N₂ gas. Steroid samples were transferred to TLC plates and developed in benzene:ethylacetate (3:1, 3 times). For both homogenates and tissue minces, conversion of cholesterol did not occur in 0.5 and 2 h samples. The synthesis of minor amounts of an unidentified nonpolar compound (presumably a cholesterol ester) occurred by 8 h in both tissue preparations. The lack of sex steroid metabolites synthesized from cholesterol indicates the absence of activity in the side chain cleaving enzyme and $\Delta 4$ - $\Delta 5$ isomerase, suggesting that cholesterol may not be the sterol precursor to sex steroids already detected in echinoderm tissues.

NESTING ACTIVITY OF THE LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) ALONG COASTAL ALABAMA. David H. Nelson, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688. Robbie J. Dailey, Bon Secour National Wildlife Refuge, Gulf Shores, AL 36542.

Field surveys for sea turtle nests were conducted from June to August, 1995 along the beaches of the Bon Secour National Wildlife Refuge (Baldwin Co.) and Dauphin Island (Mobile Co.), Alabama. Beaches were checked three times a week by all-terrain vehicle to identify, locate, protect and mark individual nests. Thirty confirmed nests and eight false crawls were recorded from June to August at the Bon Secour National Wildlife Refuge. An additional 18 nests were reported from nearby Gulf Shores and Orange Beach. Hatchling success for 4 clutches ranged from 0% to 98% (mean = 47.5). Because of severe storm erosion during an active hurricane season, 14 nests could not be relocated. Although field surveys on the west end of Dauphin Island revealed no nests, two false crawls were observed. Vacationers reported three nests and one sighting of hatchlings. Over the summer on Dauphin Island, there were 12 strandings of dead sea turtles: 3 leatherbacks, 4 loggerheads and 5 Atlantic Ridleys. On the Bon Secour National Wildlife Refuge, there were four stranded loggerheads.

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COMPARISON OF *c-kit* FUNCTION IN NORMAL AND CANINE CYCLIC HEMATOPOIETIC DOGS. M. Brad Guffey, Glenn P. Neimeyer, and Clint D. Lothrop, Jr., Scott-Ritchey Research Center, Auburn University, AL 36830.

Canine cyclic hematopoiesis (CH) is an autosomal recessive disease that is an animal model of human cyclic neutropenia. Hematopoietic cycles in the dog model have a 14 day periodicity with 2 to 4 day days of neutropenia. These cycles are associated with concurrent cycles of thrombocytosis and reticulocytosis followed by a marked monocytosis. Elevated serum levels of IL-1, IL-6, and G-CSF in CH dogs is postulated to be a rescue mechanism stimulating myelopoiesis. The CH dog is a unique model of undetermined etiology to study hematopoietic regulatory control mechanisms as well as signal transduction events important in the regulation of steady state hematopoiesis. In dogs, CH is both curable and transferable by bone marrow transplantation. This suggests a disorder of the pluripotent hematopoietic stem cell (PHSC) in which a periodic failure of cell production causes neutropenia. Pharmacological but not physiological doses of G-CSF stop CH cell cycles indicating a potentially related malfunction in the G-CSF pathway. Avalos *et al.* have reported that bone marrow mononuclear cells (BMMCs) from CH dogs require sevenfold higher G-CSF concentrations to achieve half-maximal colony growth (*Blood* 84: 789-794, 1994). We recently found that BMMCs from CH dogs have a decreased responsiveness to recombinant canine stem cell factor (c-kit ligand) [half-maximal colony growth 190 pmol/L versus 500 pmol/L, normal and CH respectively], a factor important in PHSC regulation. These results suggest that CH is caused by a defect in a signal transduction component common to multiple pathways or that altered responsiveness to SCF at the stem cell level leads to apparent abnormalities in other lineages. Cytokine receptors, in particular GM-CSF and SCF, are known to use common signal transduction intermediates. The basis for decreased responsiveness of CH BMMCs to G-CSF and SCF is being investigated by comparing the RAS/MAP kinase (MAPK) signal transduction pathway in PMNs and BMMCs from normal and CH dogs. Western blot analysis of BMMCs from normal and CH dogs with c-kit antisera demonstrated a 120 kD band in both normal and CH dogs. Western blot analysis on BMMC lysates from normal and CH dogs performed with antibodies to the signal transduction intermediates GRB2, JAK2, MAPK, Ras, SOS, and VAV were similar as was MAPK phosphorylation in PMNs. PMNs are non-proliferative and do not express c-kit; therefore, we are currently examining phosphorylation of MAPK in BMMCs from normal and CH dogs stimulated with G-CSF, GM-CSF, and/or SCF. Comparison of hematopoietic growth factor signal transduction mechanisms should provide insight into the molecular basis for CH and the regulatory processes governing hematopoiesis.

REPRODUCTIVE PERIODICITY AND VARIATION IN THE ECHINOID LYTECHINUS VARIEGATUS IN THREE CONTRASTING MICROHABITATS. Steven D. Beddingfield and James B. McClintock, Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

Lytechinus variegatus is a widely distributed regular echinoid found in abundance in St. Joseph's Bay, Florida. Field investigations indicate this echinoid inhabits Thalassia, Syringodium and sand/Enteromorpha dominated microhabitats within the bay. Differences occur in relative gonad size, as well as in the timing of gamete maturation and spawning, in individuals inhabiting these different microhabitats. These variations may be related to differences we have documented in microhabitat-specific temporal and spatial patterns of food availability as there were significant qualitative differences in the diets of L. variegatus between sites. In addition, laboratory studies indicate differential growth of the gonads of L. variegatus occurs in response to qualitative characteristics of their natural diets. This work was supported by NSF EPSCoR Grant #R11-8996152 to J.B. McClintock and by the UAB Department of Biology.

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GROWTH OF PROCAMBARUS CLARKII HATCHLINGS USING FORMULATED DIETS.

Lalitha D. Saripalli and Stephen A. Watts, Dept. of Biology, Univ. of Alabama at Birmingham, 1300 Univ. Blvd., Birmingham, AL 35294-1170.

The need for cost-effective formulated diets has increased to supplement the traditional forage-based culture of crayfish in U.S. A 10 week laboratory growth trial was conducted with red swamp crayfish Procambarus clarkii hatchlings to evaluate practical feed formulations and specific dietary supplements. The protein content of the feeds ranged from 28 to 51%. The main sources of plant and animal protein were soybean meal and fish meal, respectively. The diets containing different combinations of plant and animal proteins, plant protein alone and animal protein alone were tested. The hatchlings in all the test diets showed 100% survivorship. Hatchlings fed KS diet (UAB Research Foundation) showed significantly higher growth rates than the other diets ($p < 0.01$). In addition, number of molts, and increase in weight per molt were higher. The instantaneous growth rates (IGR) varied from 2.5 - 4.2%/d, depending on the diet. Hatchlings fed the KS diet containing both plant and animal protein have the highest caloric content (4.2 k cal/g dry wt), and high energy retention (6.41 k cal/individual). The hatchlings fed on only plant protein (KFM 0) or animal protein (ABS and AB) showed poor growth rates (2.8, 2.7 and 2.9%/d, respectively, $p < 0.05$), few molts, and increase in weight per molt averaged 0.152 ± 0.05 , 0.126 ± 0.04 and 0.138 ± 0.02 g, respectively. Sex has no effect on the growth (one way ANOVA, Fisher's LSD). These studies indicate that the hatchlings of P. clarkii require both plant and animal proteins in their diets during early developmental stages for the fast growth.

GEOGRAPHIC DISTRIBUTION OF THE ALABAMA REDBELLY TURTLE (PSEUDEMYX ALABAMENSIS) IN THE MOBILE-TENSAW DELTA. David H. Nelson, Jarrod H. Fogarty and William M. Turner, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688.

The Alabama redbelly turtle (Pseudemys alabamensis) is an endangered species endemic to freshwater habitats within the Mobile-Tensaw delta. To determine specific locations where the turtles occur, hoop traps with lead nets were placed systematically in a number of sites within the Mobile-Tensaw delta from June to October, 1994 and 1995. Specimens were identified, sexed, aged, measured, marked, weighed and photographed. During the 8-month field study, a total of 341 turtles were captured (including 70 Alabama redbelly turtles). Specimens of Pseudemys alabamensis were encountered in 21 of the 29 areas trapped. Alabama redbelly turtles did not appear to be extremely abundant in any of the areas studied; none were captured in the three northernmost tributaries trapped (Middle River, Mifflin Lake, Dennis Lake). Other turtles encountered included the Delta map turtle (Graptemys nigrinoda) (n=76), the River cooter (Pseudemys concinna) (n=70), the Red-eared slider (Trachemys scripta) (n=62), the Spiny softshell (Apalone spinifera) (n=36), and the Alligator snapping turtle (Macroclemys temminckii) (n=27). Forty-two American alligators and 24 species of fishes were also trapped. The study documents the presence of Alabama redbelly turtles in 15 previously unreported locations.

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PRODUCTION OF TRANSGENIC COTTON PLANTS EXPRESSING INSECTICIDAL PROTEINS. Nelson Moseley, Bill Moar, Henry Daniell. Dept. of Botany and Microbiology, 101 Life Science Building, Auburn University, Auburn, AL 36849-5407.

The use of chemical insecticides in today's world is under considerable scrutiny. Their efficiency is questionable, they are harmful to the environment, and industrial production of these insecticides pollutes the atmosphere. Fortunately, the application of genetic engineering methodologies is providing us with answers to these problems. The introduction of Bacillus thuringiensis genes coding for a crystalline insecticidal protein into plant genomes leads to a biological insect resistance. CryIIA is a B.t. gene that codes for insecticidal proteins lethal to various Lepidopteran insects, such as the tobacco budworm, Heliothis virescens, a common cotton pest. These proteins work by binding to receptors inside the gut during digestion and destroying it. Vector construction consists of preparing the CryIIA gene through restriction digestion of the plasmid pMTS6 with BamHI and EcoRV. The CryIIA gene can then be ligated with the plant expression vector PBI-XZ-120mer which is prepared by restriction digestion with BamHI and SmaI. After transformation and inoculation, the plasmid DNA can be isolated, and the recombinants can be screened by restriction digestion with the proper enzymes. The completed vector can be introduced into the plant via Agrobacterium tumefaciens or microprojectile bombardment with the gene gun.

THE EFFECTS OF OKADAIC ACID ON mRNA LEVELS OF CYCLIN GENES IN HeLa CELLS. Lindy Gewin and R. C. Bird, Dept. of Pathobiology, Auburn University, AL 36849.

Much of current cancer research focuses on the mechanisms which control the cell cycle in an attempt to discover how these systems are disrupted in cancer cells. The cell cycle is regulated by a complex system of cyclins and cyclin-dependent kinases (cdk's) which exert their control over the cell cycle by phosphorylating specific substrates within the cell. We are attempting to study this control at a transcriptional level with a drug known as okadaic acid. Okadaic acid, originally extracted from a marine sponge, is a specific inhibitor of phosphatases 1 and 2a. When introduced to human cervical carcinoma (HeLa) cells in culture, okadaic acid is thought to perturb the signal transduction system thereby mimicking a normal response to growth factor. Previous research (You & Bird, 1995) has shown that okadaic acid treatment causes increased levels of mRNA encoding cyclins A and B, the tumor suppressor gene, *Rb*, and *cdk1*. We propose that the increased levels of expression are caused by (1) increased transcription rates of these genes, (2) increased stability of the mRNA encoding these genes, or (3) some combination of the previous two.

INVOLVEMENT OF MICROTUBULES IN PROTHORACICOTROPIC HORMONE-STIMULATED ECDYSTEROIDOGENESIS BY INSECT PROTHORACIC GLANDS. R. Douglas Watson, Dept. of Biology, Univ. of Alabama at Birmingham, AL 35294. Shari Ackerman-Morris and Wendy A. Smith, Dept. of Biology, Northeastern Univ., Boston, MA 02115. Walter E. Bollenbacher, Dept. of Biology, Univ. of North Carolina, Chapel Hill, NC 27599.

Secretion of ecdysteroid molting hormones by insect prothoracic glands is stimulated by neuropeptide prothoracicotropic hormones (PTTH). Studies were conducted to assess the effects of microfilament and microtubule inhibitors on in vitro ecdysteroidogenesis by prothoracic glands of Manduca sexta. Microfilament inhibitors (cytochalasins B and D) had no effect on basal or PTTH-stimulated ecdysteroidogenesis. Microtubule inhibitors (colchicine, podophyllotoxin, nocodazole) had no effect on basal secretion, but suppressed PTTH-stimulated secretion in a concentration-dependent manner. The effect of nocodazole was partially reversible, suggesting it was not due to nonspecific toxicity. Colchicine had no effect on glandular ecdysteroid levels, indicating that inhibition was not due solely to blockage of secretion. The combined results are consistent with the hypothesis that microtubule-mediated transport of ecdysteroid precursors plays a critical role in stimulation of ecdysteroidogenesis by PTTH. Supported by grants from NIH (HD-06700, R.D.W.; DK-31624, W.E.B.), USDA (NRI-94-37302-0543, W.A.S.), and NSF (DCB-8819924, W.E.B.).

CRAYFISH AQUACULTURE IN ALABAMA. Mark E. Meade and Stephen A. Watts Biology Dept., University of Alabama at Birmingham, Birmingham, AL 35294.

Crayfish culture in the US is the largest among crustacean species. Yearly production of crayfish in Louisiana in 1993 was estimated at 60-70,000 tons valued at over \$150,000,000. Imported crayfish account for 3 to 4 times the amount of crayfish currently produced in the US and are steadily increasing. In order to compete with imports and global exports, methods of increasing domestic production of crayfish are being investigated. Crayfish have recently been introduced to aquaculturists in Alabama as an alternative culture species. Only a few hundred acres of crayfish farms are in production in Alabama at present. However, as technological advances are made, the number of farms throughout Alabama and the southeast will inevitably increase. Currently, UAB and Gadsden State Community College (GSCC) are investigating methods of improving current methods of crayfish production. Specifically, production capabilities when using formulated crayfish feeds are being examined and compared to production in traditional, forage-based systems. It has been estimated that, through such improvements in culture methods, crayfish production in the United States could reach 100,000 tons by the year 2000.

SUPEROVULATING NZW RABBITS: MAXIMIZING EMBRYO YIELDS WHILE MINIMIZING HYPEREMIC UTERINE CONDITIONS. Jacqueline U. Johnson and Adriel D. Johnson, Alabama A & M University and University of Alabama in Huntsville

A wide range of gonadotropin regimens for superovulating the rabbit appears in the literature without specificity to breed type. Protocols using single doses of PMSG ranging from 25 - 200 i.u. have been commonly used, yet unsatisfactory embryo yields continue to favor the use of FSH which requires more frequent administration. Reproductive tracts of New Zealand White Rabbits (NZW) are highly sensitive and variable in response to gonadotropin stimulation. This sensitivity results in edematous, hyperemic oviducts and/or uterus which makes flushing difficult and embryo recovery low. The purpose of our investigation was to determine a satisfactory ratio of PMSG:HCG which would minimize the hyperstimulatory effects exhibited in NZW rabbits without compromising embryo yield and to determine also if age, interval between PMSG & HCG injections and season, attributed to variations in expected embryo yield. Our findings show that 75 i.u. PMSG + 25 i.u. HCG is a satisfactory regimen in NZW rabbits to minimize hyperemic conditions of the oviduct and uterus while facilitating consistent embryo recoveries. Lengthening the interval between PMSG and HCG + mating (72 - 84 hr. apart) increases sexual responsiveness but the mean number of embryos recovered does not differ significantly (23.07 ± 1.40 & 21.53 ± 2.52). Age at the time of superovulation and season both attribute to variations observed in embryo yield within this breed, however, a reliable recovery can still be expected with this combination.

HERON COLONIES NEAR TUSKEGEE, ALABAMA. Julian L. Dusi, Dept. of Zoology and Wildlife Science, Auburn University, Auburn University, AL 36849. Rosemary D. Dusi, 560 Sherwood Drive, Auburn, AL 36830.

During the period from 1952 to 1995, seven heron colony sites have been found in Tuskegee and its vicinity. From 1952 - 1958, a Little Blue Heron (Egretta caerulea) colony was on the Hog Wallow Ponds site, two miles south of Tuskegee. The site by the Tuskegee Holiday Inn, now Tuskegee Inn, was occupied by Little Blue Herons and Cattle Egrets (Bubulcus ibis) from 1970 - 1978. In 1977, another colony was present on Motley Road, in northwestern Tuskegee. The Colbert Road site in Tuskegee was active from 1979 - 1980. Cattle Egrets attempted to form a colony at 402 Benson on Dr. Judkins property, just west of the Colbert Road site, in 1981, but were harassed by the police and caused to leave. No new colonies were formed until 1991, when a Cattle Egret/Little Blue Heron colony appeared back in the Hog Wallow Ponds. This colony was active until 1994, when the trees they were nesting in were all killed by the egrets feces. In 1995, a Cattle Egret colony appeared in Cat Swamp, near Shorter, in what we believe was a Wood Stork (Mycteria americana) colony. We do not know why these herons picked Tuskegee for colony sites.

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CHARACTERIZATION OF A SOLUBLE TRYPSIN INHIBITOR SENSITIVE ENZYME IN MURINE EPIDIDYMAL FLUID. Zachary Barksdale, David Aarons* and G.R. Poirier, Dept. of Biology, Talladega College, Talladega, AL 35160 and Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294-1170.

Trypsin-like sites on the surfaces of mammalian sperm participate in zona binding. One of these sites, a trypsin inhibitor sensitive site, has been partially characterized based on its ability to hydrolyze 4-methylumbelliferyl p-guanidiobenzoate (MUGB), an active site titrant of trypsin. Approximately 95% of the enzyme activity associated with cauda epididymal sperm is soluble. If the sperm bound fraction participates in zona binding it may be difficult to assign a role to the soluble portion. As an attempt to define the role of the soluble enzyme this presentation deals with its characterization. Crude preparations were obtained by centrifugation of cauda epididymal sperm suspension. Final purification was achieved by molecular sieving (G-100) and affinity chromatography using arginine as the ligand. SDS-PAGE (7%) of the purified preparation showed two bands (70 and 61 kDa). Kinetic analysis using MUGB as the substrate indicate a K_m of 8.5 μM and a V_{max} of 4.3 nmol/min/mg. MUGB hydrolysis is blocked by proteinase inhibitors including soybean trypsin inhibitor, nitrophenyl guanidinobenzoate and an inhibitor isolated from the seminal vesicles of mice. Heat solubilized zonae is 1000x more potent an inhibitor of MUGB hydrolysis than is soybean trypsin inhibitor. The active zonae component is ZP3, the zona component which binds the fertilizing sperm. The function of soluble enzyme is not immediately obvious but the data presented here suggest a possible role in the fertilization process.

OVARIAN PROTEIN LOCALIZATION IN INSECT FOLLICLES USING CONFOCAL MICROSCOPY. B. H. Estridge and J. T. Bradley. Department of Zoology, Auburn University, Auburn, AL 36849, USA.

Confocal laser scanning microscopy and yolk protein (YP)-specific monoclonal antibodies (MABs) were used to characterize routes of YP uptake and ooplasmic distribution in developing follicles of the stick insect, *Carausius morosus*, and the house cricket, *Acheta domesticus*. Using indirect immunofluorescence and FITC-labeled secondary antibody, patterns of three MABs generated against *Carausius* YP and two generated against *Acheta* YP were examined. In *Carausius* vitellogenic follicles, river-like channels between polygonally shaped follicle cells (FC) and vesicles beneath the FC layer were delineated with MAB 1B12, specific for vitellin (Vn) polypeptide A3 (60 kD), and with MAB 4G12, specific for an 85 kD non-Vn yolk polypeptide. MAB 1C3, directed against *Carausius* Vn A2 (107 kD), also reacted with vesicles in early vitellogenic oocytes but stained the inter-FC spaces in a punctate pattern. In *Acheta*, MAB 1E10, specific for both YP-1 and YP-2b (180 and 107 kD, respectively), stained material in channels between FC along the mid region of vitellogenic follicles and in vesicles of the proximal ooplasm; FC channels in the region of the nucleus did not stain. MAB 2D1, specific for *Acheta* YP-2b only, did not react with inter-FC material but stained nuage bodies in pre-vitellogenic follicles. Supported in part by funds from the Alabama Agricultural Experiment Station, Project 862, to J.T.B.

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ANTI-ECDYSONE AND ANTI-VON WILLEBRAND FACTOR REACTIVITY WITH INSECT VITELLOGENIN AND VITELLIN. Austin Hitt and James T. Bradley, Department of Zoology and Wildlife Science, Auburn University, Auburn, AL 36849.

Insects that develop from amniotic eggs require large concentrations of vitellin (VN) and the sterol hormone ecdysone. Vitellogenins (VG), the hemolymphatic precursors of VNs are taken up via receptor-mediated endocytosis, but the pathway of ecdysone entrance is less certain. We examined the reactivity of VG/VN polypeptides by Western blotting using two anti-ecdysone antibody preparations (produced by W.E. Bollenbacher, U.NC Chapel Hill, and distributed by E.S. Chang, Bodega Marine Laboratory, Bodega Bay CA). The B series of antibody, directed against the C20 side chain, produced only negative results in all insects examined. Blots using the A series of antibody, directed against the nucleus of ecdysone, reacted with specific VG/VN peptides in the three insects examined: 52.5 kDa VG/VN peptide in *Acheta domesticus*, 220 and 108 kDa VG/VN peptides in *Carausius morosus* and a 161 and 153 kDa non-yolk egg protein of *Drosophila melanogaster*. In *A. domesticus* during days 6-7 of embryonic development a significant decrease in ecdysone reactivity occurs. The loss of reactivity coincides with increases in the levels of the ecdysteroids in the egg of *Acheta* (Whiting et. al. 1993, Ins. Biochem. Molec. Biol 23: 319). Blots using anti-human von Willebrand Factor (VWF), (Sigma Chem. Co.) Exhibited reactivity with the VG/VN peptides of *A. domesticus* and *C. morosus* that also reacted the strongest to anti-ecdysone A (152.5 kDa and 108 kDa respectively). No reactivity was observed from *D. melanogaster* egg proteins. Our results support the hypothesis that (1) ecdysone is transported into the egg via receptor mediated endocytosis of VG (2) ecdysteroid levels are regulated by programmed VN proteolysis, and (3) ecdysone binding to VG/VN occurs in connection with VWF sequence homology. (Supported by Alabama Agricultural Experiment Station Project 862 to J.T.B.)

QUANTIFICATION OF PIGMENT ALLELE EXPRESSION IN SAILFIN MOLLIES USING IMAGE ANALYSIS. Brinda Dass and Robert Angus, Dept. of Biology, Univ. of AL at Birmingham, Birmingham, AL 35294.

The melanistic "salt-and-pepper" phenotype in sailfin mollies (*Poecilia latipinna*) results from the presence of abnormally large pigment cells called macromelanophores, the presence of which is determined by a single autosomal gene. The macromelanophore allele shows highly variable expressivity which, based on previous qualitative observations, appears primarily to be the result of temperature sensitivity. We used computer image analysis to quantify the degree of expression of the macromelanophore-determining gene. Pigment cells develop in the dermis of these fish, spread laterally and are easily visible, making image analysis an effective technique for determining the percentage of the total surface area covered by macromelanophores. Fish heterozygous for the macromelanophore allele were reared from birth in constant-temperature baths at 22°, 25° and 28° C. Each fish was photographed at regular intervals and the percent macromelanophore coverage determined. Maximum expressivity of the gene was observed at 22°. Very little expressivity was seen at 25° and 28°. The gene also exhibited sex-influenced expression. At each temperature, males showed higher expressivity than females.

POPULATION DYNAMICS OF OPHIODERMA BREVISPINUM IN TWO SEA GRASS HABITATS ALONG AN ENVIRONMENTAL GRADIENT IN PORT SAINT JOSEPH'S BAY, FLORIDA. Clare L. Williams and James B. McClintock, Dept. of Biology, Univ. of Ala. at Birmingham, 35294.

The population dynamics of Ophioderma brevispinum studied over a one year period, January - December 1995, demonstrated seasonal fluctuations in densities with a range of 23.3/m² in February to 0.6/m² in May at a far-shore site, and 17.5/m² in March to 0.5/m² in June at a near-shore site. Densities of individuals increased from August to December, with no significant numbers of juvenile recruits indicating seasonal migration of adult ophiurids into these sea grass beds. Increases in population density at the near-shore site was delayed with respect to the far-shore site. Mean disk diameter values for the two sites were significantly different in February, March, July, and September. Sub-lethal predation, as measured by numbers of arm tips regenerating, was not significantly different between the two sites except for the month of February, when regeneration was higher at the far-shore site. Supported by NSF-EHR-9108761.

CHARACTERIZATION OF A MEMBRANE BOUND TRYPSIN INHIBITOR SENSITIVE SITE ON MURINE SPERM. David Aarons and Tajuan M. Woody, Dept. of Biology, Talladega College, Talladega, AL 35160 and Zachary Barksdale and Gary R. Poirier, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294-1170.

Guanidiobenzoate (GB) is a cell surface trypsin-like enzyme thought to be associated in cancer metastasis, cell migration and tissue remodeling. Its presence on murine sperm has been associated with sperm zona binding. The purpose of this presentation is to characterize this enzyme and to verify its zona binding function. Kinetic studies using twice washed cauda epididymal sperm and 4-methylumbelliferyl p-guanidiobenzoate (MUGB) as the substrate indicate a K_m of 4.3 μM and a v_{max} of 21.2 nmole/min/10⁶ sperm. The rate of MUGB hydrolysis is Ca^{++} dependent and is directly proportional to the number of sperm. A proteinase inhibitor, isolated from the seminal vesicles of mice, is a potent inhibitor of the cell bound enzyme and does so in a non-competitive fashion. ZP3, the zona pellucida glycoprotein that is responsible for sperm zona binding, will inhibit hydrolysis of MUGB while the other two zona components (ZP1 and ZP2) have no effect. The above data support the suggestion that GB functions in sperm-zona binding.

Abstracts

Lived Experiences of Women in Treatment for Weight-Loss:
A Feminist Analysis (Kay M. Lopez), Dept. of Nursing,
University of Alabama At Birmingham, Al., 35294-1210

Because of their concern with body size, women are the primary users of weight treatment programs. Since weight treatment programs have poor long term outcomes, many women return for treatment time after time. This phenomenologic study, guided by feminist theory, explored women's experiences with weight treatment, as well as the personal meanings they attached to these experiences. Subjects were recruited from three types of weight treatment programs and were interviewed using Seidman's method. The theme of value conflict was evident in the subject narratives. These women had difficulty balancing the requirements of their programs with their perceived obligations as spouses, parents, and breadwinners. Subjects who were not severely obese were motivated by appearance concerns, rather than health, to enter treatment. One study conclusion was that ambiguity between health and attractiveness as reasons for seeking weight-loss perpetuates the value conflict of women in treatment. A study implication was that nurses counseling women who seek weight-loss should promote values clarification of clients so that they can make more informed decisions regarding weight management within the context of their personal lifestyle priorities.

GENETICALLY ENGINEERING DROUGHT TOLERANCE IN CULTURED TOBACCO CELLS USING THE MAIZE SORBITOL DEHYDROGENASE GENE

Sheila R. Lawrence (Dr. Henry Daniell, Dr. Robert Locy), Department of Botany and Microbiology, Auburn University, Auburn, AL, 36830.

Research has shown that the accumulation of various osmoprotectants within the cytoplasm of higher plant species protects some tissues against damage due to desiccation. Sorbitol has been shown to be such an osmoprotectant. Sorbitol Dehydrogenase (SDH), which catalyzes the synthesis of sorbitol from fructose, has been isolated from corn kernels. Monoclonal antibodies prepared against the purified enzyme were used to obtain a cDNA clone for this protein from a maize endosperm cDNA library. DNA vector construction involving the SDH gene, the nptII gene (which gives kanamycin resistance and acts as a selectable marker), the CaMV35S promoter, and nos terminator will be completed. After stable transformation into cultured tobacco cells using either the Agrobacterium or Gene Gun method of transformation, stress tolerance in the transformed cells will be evaluated.

Abstracts

PHOTOSYNTHETIC RESPONSE TO LONG-TERM AND SHORT-TERM CHANGES IN CARBON DIOXIDE IN SWEETPOTATOES GROWN HYDROPONICALLY WITH ENHANCED MINERAL NUTRITION. Casey Johnson, Douglas R. Hileman, Desmond G. Mortley and Jill Hill, Dept. of Biology and Dept. of Agricultural Sciences, Tuskegee Univ., Tuskegee, AL 36088.

Sweetpotato [Ipomoea batatas L.(Lam)] has been selected by NASA as a potential food for long-term space missions. In previous experiments, sweetpotato plants grown hydroponically under elevated levels of CO₂ depleted the nitrogen in the nutrient solution between the bi-monthly solution replacements. In this experiment, the effect of enhanced nutrient replenishment on photosynthetic rates of sweetpotato was determined. CO₂ response curves were determined for 'TI-155' and 'Georgia-Jet' sweetpotatoes grown hydroponically in growth chambers at three different CO₂ concentrations (400, 750, and 1000 $\mu\text{mol mol}^{-1}$ CO₂). Gas exchange measurements were made using infrared gas analysis, an open-flow gas exchange system, and a controlled-climate cuvette. Photosynthetic measurements were made at CO₂ concentrations from 50-1000 $\mu\text{mol mol}^{-1}$ CO₂. Net photosynthetic rates showed an increase with increasing measurement CO₂ in all nutrient regimes, but the response of photosynthetic rates to the growth CO₂ conditions varied among the experiments and between the two varieties. Net photosynthetic rates tended to increase with enhanced nutrient replenishment, but the increase was not consistent. The results of this study will help to determine the CO₂ requirements for growth of sweetpotato in the proposed space station. (Supported by NASA.)

DEMOGRAPHY, DIET, AND PREY AVAILABILITY OF FLATTENED-MUSK TURTLES (STERNOTHERUS DEPRESSUS). Karan A. Schnuelle and Craig Guyer, Department of Zoology and Wildlife Science, Auburn Univ., Auburn, AL 36849.

The flattened musk turtle, Sternotherus depressus of the Black Warrior River Basin, was designated a threatened species in 1987, after declines in populations were reported. Investigators concluded that the density and distribution of many populations of S. depressus had declined due to habitat degradation. It was suggested that the absence of certain food items necessary for juvenile S. depressus may be the limiting resource. The objectives of this study were to (1) compare current demography of S. depressus with that indicated by previous samples, (2) document the relationship between stream water quality and invertebrate abundance and diversity, and (3) begin assessment of the hypothesis that food available for young turtles is a major limiting factor. One hundred and twenty-seven S. depressus were captured from 15 April to 30 August 1995. The overall sex ratio of 93 adult S. depressus was 50 males to 43 females. An ontogenetic diet shift from arthropods to mollusks was observed. Caddisfly larvae were the predominant prey for juvenile S. depressus whereas adults preferred the native snail, Elimia. Population estimates and decreased trapping success indicate that populations of S. depressus have continued to decline.

Abstracts

STEROID LEVELS DURING EARLY DEVELOPMENT OF THE TILAPIA *OREOCHROMIS NILOTICUS*. Gene A. Hines¹, Stephen A. Watts¹ and Larry R. Boots². Departments of ¹Biology and of ²Obstetrics and Gynecology, University of Alabama at Birmingham.

The levels of steroids before (eggs to 15 days postfertilization [dpf]), during (22 to 50 dpf), and after (64 dpf) the presumed period of sexual differentiation in tilapia were investigated by radioimmunoassay of androstenedione (A₄), testosterone (T), 11-ketotestosterone (KT), and estradiol (E₂) from whole-organism extracts of *Oreochromis niloticus* (Teleostei: Cyprinidae). Values were expressed as amount of steroid per g fresh tissue weight. Levels of androgens were initially high in eggs (A₄ = 3600 pg/g, T = 450 pg/g, KT = 20 ng/g) and decreased until 15 dpf. A₄ levels remained low (< 300 pg/g) through 64 dpf. T levels increased after 15 dpf with transient peaks at 22 dpf (250 pg/g) and 50 dpf (300 pg/g). KT levels peaked at 22 dpf (45 ng/g) then gradually decreased through 64 dpf. E₂ levels were low (< 200 pg/g) or undetectable, but increased markedly at 43 dpf (> 2000 pg/g). The initial (eggs to 15 dpf) decrease in steroid levels may represent metabolism or utilization of maternally-derived steroids. The increases in levels of androgens between 15 and 22 dpf indicate endogenous biosynthesis, suggesting that androgen production of the developing organism may coincide with the onset of sexual differentiation. Corroboratively, historical treatments of developing tilapia with exogenous androgens and estrogens cause physiological masculinization and feminization, respectively. Hence, we hypothesize that the early androgen surge may be important for male sexual differentiation while the later surge in E₂ may be important for ovarian development. Further investigations are required to clarify whether the onset of steroid synthesizing capacity (and eventual/potential sex-specific differences in steroid levels) in teleosts is causal to or resulting from sexual differentiation.

PRELIMINARY RESULTS ON BREEDING PHENOLOGY OF AMBYSTOMA

MACULATUM. Eric A. Blackwell and George R. Cline, Dept. of Biology, Jacksonville State Univ., Jacksonville, AL 36265.

A drift fence with eight sites containing pitfalls on the inside and outside of the fence, was constructed around a small pond located in Calhoun County Alabama during October 1995. The fence was constructed to monitor breeding activity in three species of salamanders; Ambystoma maculatum, A. opacum, and Notophthalmus viridescens. From the capture data, sex ratios and potential migration routes of the Ambystomatid salamanders were determined. This design also allowed a minimum population size to be estimated for Ambystoma maculatum. A previously started species list of herptiles in and around the pond was expanded by three salamander species, Plethodon glutinosus, P. serratus, and P. dorsalis; one skink Scincella lateralis; and one frog, Gastrophryne carolinensis.

SEX-SPECIFIC 5 β -REDUCTASE ACTIVITY IN THE GONADS OF THE NILE TILAPIA *OREOCHROMIS NILOTICUS*. W. Tony McKenzie, Kristina M. Wasson, Gene A. Hines, and Stephen A. Watts, UAB, Birmingham, Alabama, 35294-1170.

Gonadal function in the mammalian testis is regulated by endogenously-produced androgens, primarily testosterone and 5 α -dihydrotestosterone (5 α -DHT), whereas testicular function in teleosts is believed to be regulated primarily by 11-oxygenated androgens such as 11-ketotestosterone. In this study, reproductively mature male and female *Oreochromis niloticus* were maintained under three social regimes: 1) isolated individuals (2 weeks) 2) same-sex groups (2 weeks) and 3) mixed-sex pairs (2 days). Gonads were excised, minced and incubated with ³H-testosterone for up to 3 h. Organic-soluble steroidal metabolites were identified by TLC, product derivatization and recrystallization. Social regime did not influence testosterone metabolism however, sex-specific differences in metabolite formation were observed. Males metabolized testosterone primarily into 5 β -androstane-3 β ,17 β -diol, 17 β -hydroxy-5 β -androstane-3-one (5 β -DHT) and 5 β -androstane-3 α ,17 β -diol (suggestively), indicating high 5 β -reductase activity. Simultaneous incubations using androstenedione indicated that 17 β -hydroxysteroid dehydrogenase activity (conversion of androstenedione to testosterone) is minimal, however in both studies 5 β -reduced compounds were preferentially synthesized from either of the androgen precursors. In contrast, females synthesized little or no 5 β -reduced steroids, indicating 5 β -reductase activity was relatively low or non-existent. We hypothesize that the 5 β -reduced androgens are the functional androgens in the tilapia testis, and are comparable to the 5 α -reduced androgens in the mammalian testis.

SPECIATION IN THE GENUS *ACRIS*. Debra S. Moore and Ken R. Marion, Dept. of Biology, Univ. of Alabama at Birmingham, and Scott F. Michael, Dept. of Microbiology, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

Cricket frogs of the genus *Acris* (Anura:Hylidae) are composed of two closely-related species, further divided into 5 putative subspecies. Morphologically the members of the genus are very similar, yet within each species there is great variability. Traditional identification and separation methodology using morphometric analyses utilize characters such as leg length, degree of toe webbing, and quality of thigh striping. This approach has proven inadequate for consistent separation of *Acris* species. Molecular analysis using the DNA sequence of a portion of the mitochondrial cytochrome B gene allows direct comparisons of individual specimens. This provides a means to delineate between the species and within the subspecies groups. In this fashion, the delineation of two subspecies has been accomplished to date.

COMB PLATES OF *MNEMIOPSIS MCCRAYDII* BEAR A MICROBIAL COMMUNITY. Darrell D. Morgan, Anthony G. Moss, and Barbara Reynolds. Dept. of Zoology and Wildlife Science, Auburn University, Auburn, AL 36849-5414.

A microbial community has been discovered on the giant comb plates of the common Gulf Coast lobate ctenophore, *Mnemiopsis mccraydii*. We have observed that *M. mccraydii* from the Gulf Coast bears a variable load of amoebae and a peritrichous ciliate tentatively identified as *Trichodina* spp. *Trichodina* harbors its own symbiont; an unknown prokaryote routinely observed in thin sections within the lateral cytoplasm. Trichodinids range in size from 28-45µm in diameter and reside upon all plates of the subsagittal, subtentacular, and auricular comb rows. *Trichodina* maintains a firm hold on its host and remains attached even during vigorous comb plate beating. *Trichodina* apparently clamps tightly to the comb plate cilia by rapidly driving ventrally-located, centripetally deployed, denticles into the comb plate to a depth of 2-3µm. Round toroidal eruptions are observed by SEM after *Trichodina* releases from the plate. The marine amoebae inhabit both the oral and aboral side of the comb plate, while the peritrichs inhabit only the aboral side. Wherever amoebae are seen on the plate, we observe substantial erosion and degradation of the comb plate cilia. The amoebae appear to produce multilamellate balls of plasma membrane, presumably a stage in the uptake of nutrients. Since similar trichodines are observed in close association with teleosts, it is likely that *Mnemiopsis* is an important intermediate host in the life cycle of marine *Trichodina*.

HABITAT PREFERENCES AND MORPHOMETRICS OF A FRESHWATER PROSOBRANCH SNAIL *Elimia carinocostata*. Leslie D. Deason and James B. McClintock, Dept. of Biology, Univ. of Alabama at Birmingham, AL 35294. Scott Brande, Dept. of Geology, Univ. of Alabama at Birmingham, AL 35294.

The habitat preference (sand and silt, gravel and sand, gravel, river moss) of the abundant freshwater prosobranch *E. carinocostata* was investigated in Roebuck Springs, Jefferson County, Alabama in the spring of 1995. Within each habitat type the density of snails was determined by counts within randomly determined 0.1 m square quadrats. A significant difference was found between the numbers of snails on sand/silt and gravel. Moreover, individuals that occurred on river moss appeared smaller than individuals on the other habitat types. In the laboratory, snails presented equal volumes of different plant species had no significant preferences. Shell geometry was measured using a computer video digitizer. Some significant differences in shell geometry were found between habitat substrates.

Abstracts

THERAPEUTIC TOUCH EFFECTIVENESS IN STRESS REDUCTION AND IMMUNE FUNCTION IN PERSONS WITH AIDS. Clare T. Garrard, Floyd College, Rome, GA 30162.

The effectiveness of Therapeutic Touch in repatterning human immune pattern subset and coping response to stress was examined in an experimental study of twenty HIV positive males. Subjects matched according to age, pharmacological treatment, and CD4 counts were randomly assigned to either an experiemntal or sham treatment group. Statistical analyses revealed a significant difference in the CD4 counts and response to a stress scale questionnaire in those individuals who received Therapeutic Touch treatment.

CHEMISTRY

CAPILLARY ELECTROPHORESIS WITH LASER INDUCED FLUORESCENCE DETECTION OF PEPTIDES WITH SINGLE LABELS. Sara Jane Sudmeier and Stephen C. Beale, Department of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294

Numerous research problems in the field of protein analyses require highly sensitive and selective analytical methods for the determination of amino acids and peptides. Recently, capillary electrophoresis (CE) coupled with laser induced fluorecence (LIF) detection has further enhanced prospects for investigations of peptides and amino acids at trace levels. Unfortunately, implementation of LIF to the detection of peptides is not straight-forward because it is usually necessary to label analytes with fluorescent tags. With peptides, solution derivatizations tend to be random, indiscriminate and nonselective which leads to multiple products. The formation of multiple peptide products, each having different reaction sites and number of tags presents, leads to confusion and complexity in CE.

We are developing a tagging methodology which utilizes the unique combination of well-characterized chemistries to introduce a single fluorescent moiety to peptides. In the method, amino groups are reductively alkylated with glyceraldehyde in the presence of sodium cyanoborohydride to yield a substituted α -amino alcohol. This method and its further development in the field of peptide mapping will be discussed.

PREPARATION AND EVALUATION OF GEL GRADIENT FOR CAPILLARY ELECTROPHORESIS. Chao-Cheng Wang and Stephen C. Beale, Dept. of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294.

A method is presented for casting step gradients in linear (noncross-linked) polyacrylamide gel concentration. An UV-Vis whole-column detector is used to profile the gel gradients cast in the capillary, while detection of fluorescein-labeled proteins is accomplished with an epi-illumination laser-based fluorescence whole-column detection system. Fluorescence images of the capillary during the separation indicate a sharpening of the zones as they traverse each interface. The potential of gel gradients in capillary electrophoresis is demonstrated with a wide molecular weight range protein sample. A mixture of proteins whose molecular weights range from 6 kdal to 97 kdal is separated in less than 15 minutes, with baseline resolution closely sized proteins that could not be resolved in a single concentration gel. Finally, analysis of several images allows for the generation of a Ferguson plot from a single injection of 5 FITC-labeled proteins.

Et₃Al/SECONDARY AMINE SYSTEMS: ROUTE TO Al-N OLIGOMERS. Eric Styron, Charles Watkins, Larry Krannich, and Steve Schauer, Department of Chemistry, University of Alabama at Birmingham, Birmingham, AL, 35294.

The reactivity of (CH₃CH₂)₃Al toward fourteen secondary amines, HR, (HR = HNMe₂, HNEt₂, HNPrⁿ₂, HNPrⁱ₂, HNBuⁿ₂, HNBuⁱ₂, HNBu^s₂, HNC₅H₁₀, HNC₆H₁₂, HNC₄H₈, HNC₄H₈NCH₃, HNBz₂, HNCy₂, and HNPh₂) has been followed by ¹H and ¹³C NMR spectroscopy. Aluminum-nitrogen containing adducts, Et₃Al•HR, were obtained and isolated from each reaction. These adducts were characterized by ¹H and ¹³C NMR, FTIR, and elemental analysis. Changes in the ¹H and ¹³C NMR chemical shifts for the reactants upon adduct formation will be discussed in terms of the steric nature of the respective amine. The spectroscopic data obtained for this series of adducts will be compared with an analogous series, Me₃Al•HR, previously reported from our laboratory. Presently we are investigating the thermolysis of the Et₃Al•HR adducts as an efficient synthetic route to the corresponding series of aminoalane dimers, [Et₂AlR]₂.

STUDIES IN AMINOGALLANE SYNTHESIS. Steven Schauer, Charles Watkins, Larry Krannich, and Charles Lake, Department of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294.

A series of thirteen aminogallane dimers, $[\text{Me}_2\text{GaR}]_2$, ($\text{R} = \text{NMe}_2$, NEt_2 , NPr^n_2 , NPr^i_2 , NBu^n_2 , NBu^i_2 , NBu^s_2 , NC_4H_8 , NC_5H_{10} , NC_6H_{12} , $\text{NC}_4\text{H}_8\text{NMe}$, $\text{N}(\text{c-C}_6\text{H}_{11})_2$, and $\text{N}(\text{CH}_2\text{Ph})_2$), have been synthesized and characterized. A majority of the compounds were synthesized by thermolysis of the corresponding Me_3Ga - secondary amine adduct, with the exception of three derivatives, which were prepared by LiCl salt elimination. Comparisons of ^1H and ^{13}C NMR chemical shift data for the series will be made to those of the corresponding $[\text{Me}_2\text{AlR}]_2$ dimers and $\text{Me}_3\text{Ga}\cdot\text{HR}$ adducts. For the case of dibenzylamine, thermolysis led to the formation an orthometallated complex $[\text{MeGa}(\text{CH}_2\text{Ph})(\text{CH}_2\text{C}_6\text{H}_4)]_2$ instead of the expected dimer. The ^1H and ^{13}C NMR chemical shift assignments for the complex have been determined using COSY, HETCOR, and NOESY 2-D NMR techniques. The assignments are consistent with the X-ray structure of the complex, which will be presented along with the structure of the $\text{Me}_3\text{Ga}\cdot\text{HN}(\text{CH}_2\text{Ph})_2$ adduct.

Synthesis and Characterization of Stabilized Dispersion of Polybutyl Methacrylate Grafted onto Silica Spheres. Lujia Bu, Jimmy W. Mays, Department of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294, and Jinchuan Yang, Xiumei Mo, and Zhongde Xu, Department of Polymer Science and Engineering, East China University of Science and Technology, Shanghai 200237, China

Monodisperse and smooth surface silica spheres with diameter of 100-200 nm were prepared and monodisperse polybutyl methacrylate (PBMA) was grafted on the surface of the spheres. The conditions to synthesize the different size of silica spheres and different graft amount of PBMA on silica spheres will be discussed. Both the bare silica spheres and PBMA grafted silica spheres were well characterized. The relationship between steric layer thickness and the PBMA graft density, solvent quality and solvent temperature was studied and the results conforms with the scale theory prediction.

GRAFT COPOLYMERS WITH IONIC SIDE CHAINS. SYNTHESIS AND CHARACTERIZATION. Marinos Pitsikalis and Jimmy W. Mays, Dept. of Chemistry, Univ. of Ala. at Birmingham, AL 35294.

Graft copolymers having polystyrene backbones and poly(*t*-butylmethacrylate), PtBuMA or poly(2vinylpyridine), P2VP side chains were prepared using the grafting "onto" method and anionic polymerization high vacuum techniques. Narrow molecular weight polystyrene was bromomethylated after the reaction with $(\text{CH}_3)_3\text{SiBr}$ and trioxane in the presence of SnBr_4 which acts as the catalyst. The bromomethylated polystyrene serves as the macromolecular linking agent for the grafting reaction of living PtBuMA or P2VP chains. Higher grafting efficiencies were obtained when P2VP was used for the grafting reaction. Post polymerization reactions transformed the side chains to polyelectrolytes. The *t*-butyl groups were hydrolysed with HCl and the resulted carboxylic groups were neutralized with methanolic NaOH. The 2VP groups were quaternized with benzyl bromide. The products were characterized by size exclusion chromatography, membrane osmometry, low angle laser light scattering and by ^1H NMR and IR spectroscopy.

AB INITIO MO STUDIES OF NITROSOMETHANE $\rightleftharpoons$ FORMALDOXIME TAUTOMERISM, Judy A. Long, Nathan J. Harris, and Koop Lammertsma, Department of Chemistry, University of Alabama at Birmingham, UAB Station, Birmingham, AL 35294.

Ab initio data are presented that evaluate the tautomerism of nitrosomethane and compares it to those of keto $\rightleftharpoons$ enol, imine $\rightleftharpoons$ enamine, nitro $\rightleftharpoons$ acinitro, and formamide $\rightleftharpoons$ formamidic acid. A complete potential energy survey at the G2 level of theory will be presented for the nitrosomethane tautomers and their ions. This survey includes the tautomeric equilibrium, ionization energies, rotation barriers, and solvent effects. The performance of the modified Tomasi isodensity surface polarizable continuum model and the incorporation of solvent molecules are evaluated to establish the significance of the solvent effect. The one-electron density analyses of neutral and ionic species are presented to highlight their electronic features. Some data using the Becke3LYP density functional theory are presented for evaluation against G2 theory.

BIVALENT CATIONS AFFECT THE FLUORESCENCE PROPERTIES OF FURA-2 IN AQUEOUS BUFFER SOLUTIONS. L. Hemmer¹, S. Pathirana², W.C. Neely¹, and V. Vodyanoy². Department of Chemistry¹ and Institute for Biological Detection Systems and Department of Physiology and Pharmacology², Auburn University, AL 36849.

A fluorescent compound, fura-2, is capable of complexing bivalent cations. This complexation results in significant changes in the fura-2 excitation spectra, presenting potential applications of this compound and its derivatives as molecular sensors for cell biology and analytical chemistry. Relative specificities of fura-2 towards Mg^{+2} , Ca^{+2} , Cd^{+2} , Cu^{+2} , Mn^{+2} , and Zn^{+2} in aqueous solutions were estimated by measurements of their excitation spectra using a SLM 4800C spectrofluorometer. Dissociation constants (K_d) for fura-2/cation complexes in pure and binary cation solutions were calculated by using Lineweaver-Burk Double Reciprocal Plots of the excitation spectra intensity and cation concentrations. The dissociation constants calculated from our data were in the order of $Mg^{+2} > Ca^{+2} > Zn^{+2} \geq Mn^{+2} > Cd^{+2} > Cu^{+2}$. This series is similar to the one found for the respective EGTA/ cation complexes in aqueous solutions. Analysis of the results of the binary mixtures allow the determination of K_d for specific cations in the presence of competing ions. These results can be used in future design of bivalent cation sensors using fura-2 and its derivatives. This work was supported by grants from FAA 93-G058, ONR N00014-90-J-1515, and the Howard Hughes Medical Institute.

A STUDY ON CHAIN FLEXIBILITY OF SEMI-RIGID POLY(t-BUTYLMETHACRYLATE). J. Zhou, Y. Wan, and J.W. Mays, Dept of Chemistry, Univ. Of Alabama at Birmingham, AL 35294

In this paper, two experimental approaches to evaluating the chain flexibility of poly(t-butylmethacrylate) (PtMBA) under the theta conditions, using Flory's characteristic ratio C_∞ , are discussed, i.e. laser light scattering and intrinsic viscosity experiments. The analyses of experimental data generate C_∞ values of ~ 14 and 20.4 based on the intrinsic viscosity and radii of gyration for PtBMA, respectively. Furthermore, our results suggest that the Flory hydrodynamic parameter Φ_0 used in the intrinsic viscosity approach is not a constant for semi-rigid polymer chains like PtBMA.

Abstracts

NTO. TAUTOMERISM, IONIZATION, AND BOND DISSOCIATIONS.

Nathan J. Harris and Koop Lammertsma, University of Alabama at Birmingham, Department of Chemistry, UAB Station, Birmingham, AL 35294.

The insensitive high-energy explosive 5-nitro-2,4-dihydro-3H-1,2,4-triazolone (NTO) and its tautomers, anions and radicals were examined by ab initio MO theory at the SCF level, and using second-order Moller-Plesset (MP2) theory and the Becke3LYP hybrid density functional. Geometries were optimized using the 6-31+G* basis set of atom-centered Gaussian functions, and energies were then computed using the 6-311+G** basis set. The Becke3LYP and MP2 geometries agree to within 0.01 angstroms for bond lengths and 0.5 degrees for bond angles. The energies for the various tautomerisation and bond dissociation processes predicted by the two methods agree to within 5 kcal/mol. The density functional method gave energies for tautomerization, ionization, and C-H bond homolysis on a small test molecule (nitromethane) which agreed with energies computed using highly accurate G2 theory to within 3 kcal/mol. Computed estimates for the gas phase ionization energy, and N-H bond homolysis energy of NTO are respectively 320 and 93 kcal/mol at 0 Kelvin, corrected for zero-point vibrational energies. The estimated energy for cleavage of the NTO nitro group is 70 kcal/mol, similar to that for C-NO₂ cleavage in nitroaromatic compounds. The mechanism for the thermal decomposition of NTO is discussed.

Dissociation Constants by Circular Dichroism Spectroscopy. Cecil L. Jones, Dept. of Chemistry, Unvi. of Ala. at Birmingham, Birmingham AL, 35294. Cecil L. Jones, Fred Fish and Donald D. Muccio.

CD spectroscopy was employed as an analytical tool to measure the binding constant and binding enthalpy of the protein RNase A with 2'CMP. The data was analyzed using a method involving global linkage analysis of the thermal response curves. The results were compared with measurements made by isothermal titration and differential scanning calorimetry. The CD spectrum of the protein-ligand complex was calculated based on the thermodynamics associated with the system. Measurement were also made in the absence and presence of a strong denaturant to show the effects of enthalpy-entropy compensations. The linear correlation between the thermodynamic parameters and GuHCl concentration will be discussed. A study was also conducted to show the advantages of CD spectroscopy over the more commonly used calorimetric techniques.

Abstracts

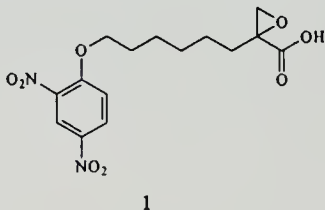
ULTRASOUND-INDUCED REACTIONS OF 4-NITROPHENOL IN SOLUTIONS OF SURFACTANTS. Mary Hinnant, Mike Cost, and German Mills, Dept. of Chemistry, Auburn University, Auburn, AL 36849.

The sonochemical transformation of 4-nitrophenol (4-NP) in aqueous solutions was studied in the presence and absence of surfactants. Acoustic cavitation of air bubbles in water results from the exposure to ultrasound waves, creating "hot spots" where reactions of 4-NP occur. In surfactant-free solutions, the transformation of 4-NP takes place mainly via high temperature reactions at the bubble-water interface; a minor reaction channel involving free radical processes is also noticed. Both reaction pathways decrease in the same proportion when the 4-NP solutions contain high concentrations of cationic or anionic surfactants. Thus, the slow transformation of 4-NP takes place through both reaction channels with the same frequency as in pure water. The inhibiting effect of the surfactants is independent on the length or charge of the surfactant molecule. In contrast, only the free radical pathway for the transformation of 4-NP is inhibited at low surfactant concentrations. Under these conditions, the transformation of 4-NP occurs mainly via high temperature reactions. These unusual results are inconsistent with current models of sonochemical reactions and suggest that the primary events of the cavitation process are modified by the presence of surfactants in the interfacial region of cavitating bubbles.

SYNTHESIS OF 2-[6-(2,4-DINITROPHENOXY)HEXYL]-OXIRANE-2-CARBOXYLIC ACID, A SELECTIVE INHIBITOR OF LIVER CARNITINE PALMITOYLTRANSFERASE I.

Tracy L. Hutchison, and Wayne J. Brouillette, Department of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294.

Carnitine palmitoyltransferase I and II (CPT-I and CPT-II) catalyze the transfer of long chain fatty acids between carnitine and coenzyme A. The acylcarnitines are transported into mitochondria where the released fatty acids undergo β -oxidation. Unlike CPT-II, CPT-I exists in at least two isoforms with different physical and kinetic properties. Liver and skeletal muscle each contain a different isoform of CPT-I. Cardiac muscle contains both isoforms in which the minor component is identical to the isoform found in the liver. The title compound (**1**), illustrated below, is reported to be a selective inhibitor for the isoform of CPT-I found in liver, but the synthesis has not been reported. A synthesis of **1** was developed utilizing the reaction of diethyl malonate with 1-bromo-6-phenoxyhexane.



ENZYMATIC DIGESTION OF CHITIN: THE SEPARATION AND DETECTION OF CHITIN MONOMERS AND OLIGOMERS BY CAPILLARY ZONE ELECTROPHORESIS. Shawn Anderson and Moore U. Asouzu, Department of Physical Science and Chemistry, Troy State University, Troy, AL 36082. Stephen C. Landers and Tom Coate, Department of Biological Sciences. Troy State University, Troy, AL 36082.

Chitin is a biologically important structural molecule produced by a variety of protozoa, fungi, and arthropods. Though well known from protozoan secretions, the presence of chitin and other carbohydrates in protozoa is mostly known from studies involving histochemical staining methods and enzymatic treatments. The results of sequential enzymatic digestion of chitin by chitinase and β -N-acetylglucosaminidase, followed by capillary zone electrophoretic characterization of the products will be presented. We aim to characterize the carbohydrates present within chitin. The development of this technique and its application to a protozoan is important, because it will enable us to establish protocols for analyzing the secretions produced by organisms of medical and veterinary importance. As only a small sample size is necessary for CE, this method is ideally suited for the biochemical analysis of carbohydrate secretions in protozoa, fungi, and arthropods.

PRODUCTION OF SALT, SULFUR, AND SALTPETER IN ALABAMA DURING THE CIVIL WAR. Richard C. Sheridan, TVA (Retired), 105 Terrace Street, Sheffield, AL 35660-6840

Nearly 2,000,000 bushels of salt were produced from wells in Clarke County and shipped into the interior of Alabama, Mississippi, and Georgia in 1861-1865. Large amounts of salt were also made at Bon Secour Bay near Mobile and from wells near Selma. Attempts to produce sulfur from iron pyrites in Tallapoosa County were unsuccessful but unknown amounts of sulfur, copperas, and bluestone were made in Talladega County (now Clay County). Probably 250,000 pounds of saltpeter were extracted from caves in North Alabama. Niter beds were established at the larger towns in central and south Alabama but were not "ripe" enough to be leached when the war ended. The production of these vital war materials will be described in some detail.

Synthesis, resolution and analgesic activity of 1-[2-(1-hydroxy-1-phenyl)ethyl]-4-(propananilido)-perhydroazepines and analogues. Jack DeRuiter, Shridhar V. Andurkar, Thomas N. Riley and Donald E. Walters, Department of Pharmacal Sciences, Auburn University.

In early studies a number of 1-aralkyl-4-(propananilido)perhydroazepines (AAPHAs) were synthesized and found to possess significant narcotic analgesic activity in animal models. Since all of the AAPHAs contain at least one chiral center (at the 4-position), it was of interest to explore the relationship between stereochemistry and analgesic activity in this structural series. Individual stereoisomers were obtained by a combination of resolution techniques and chiral synthesis. The intermediate racemic 4-anilidoperhydroazepine (APHA) was prepared in 3 steps from commercially available starting materials and resolved by formation of diastereomeric salts with D- and L- dibenzoyltartaric acids followed by fractional recrystallization. The individual APHA enantiomers were then N-alkylated and propionylated to yield the AAPHA products. In cases in which the 1-aralkyl side chain also contained an asymmetric center, chiral alkylating agents were used. Thus treatment of each of the enantiomers of APHA with (R)- and (S)-styrene oxide yielded the four stereoisomeric 1-[2-(1-hydroxy-1-phenyl)ethyl]-4-(propananilido)perhydroazepines. Preliminary pharmacological testing indicates that analgesic activity is dependent upon the configuration of C-4 of the perhydroazepine ring, and on the configuration of chiral centers in the 1-aralkyl side chain.

A COMPARISON OF ACCOMMODATION METHODS FOR STUDENTS WITH PHYSICAL DISABILITIES IN LABORATORY COURSES. C.A.L. Mahaffy and J.E. Teggin, Department of Chemistry, and N. McDaniel and G. Wolfe, Center for Special Services, Auburn University at Montgomery, Montgomery, AL 36117-3596, USA

This presentation compares and contrasts examples in the large range of accommodations that have been employed for students with disabilities enrolled in chemistry laboratory courses in the United States. These include custom-made laboratory benches, motorized wheel-chairs with adjustable seat heights, and transparent hoods over individual work stations. In contrast, many simple and inexpensive modifications such as the use of beakers with handles and easily constructed adjustable height benches can significantly enhance the working environment for many students. Measures that have proved to be effective for individual students with disabilities at Auburn University at Montgomery will be discussed.

GELATION OF POLY(VINYL ALCOHOL) WITH BORAX IN STRONGLY ALKALINE SOLUTION. Michael B. Moeller, J. Marcel Burney and Heather Higdon, Department of Chemistry and Industrial Hygiene, University of North Alabama, Florence, AL 35632.

Aqueous gels exhibiting unusual rheology can be prepared with poly(vinyl alcohol) (PVA) and borate ion. If made sufficiently alkaline, these gels might find application in the safe removal of lead containing alkyd resin paints. In this study formulations containing borax, sodium hydroxide, and 2-3 wt% PVA were prepared and, if a stable gel or liquid was produced, the viscosity at 25°C was determined. These systems showed a tendency to coagulate with instability caused by a salt effect from the sodium hydroxide and further promoted by the cross-linking of the polymer with the borate. Without additional components, stable gels appear be limited to a maximum of approximately 1.0 M hydroxide. By adding low molecular compounds to the formulations, stable gels with hydroxide concentrations as high as 2.0 M were acheived. For 2.5% PVA in alkaline solution, the liquid-gel transition occurs at approximately 0.25 mM total borate concentration. Analysis of the viscosity data for neutral and alkaline solutions suggests that approximately 25% of the borate is complexed with the PVA under these conditions.

AB INITIO STUDIES OF NITRAMIDES AND NITROSAMIDES. Tracy P. Hamilton and Zhi Chen, Department of Chemistry, University of Alabama at Birmingham, AL 35294.

Ab initio calculations of nitramides and nitrosamides (mono-, di- and tri-) are reported. Nitramides are nitro substituted ammonias and nitrosamides are nitroso substituted ammonias. The geometries, heats of formation and N-N bond strengths are predicted by using theoretical methods with demonstrated high accuracy. Nitramides are well known high energy-density materials. Converting the nitro groups to nitroso groups should result in compounds that have lower weight and shorter N-N bond lengths, are higher in energy content, and are less sensitive.

THE PREDICTION OF THE ^{19}F NMR OF FLUOROARENES USING SYMMETRICAL MATHEMATICAL MODELS. R.E. Jetton and J.R. Nanney, Department of Mathematics, C.A.L. Mahaffy, Department of Chemistry, Auburn University at Montgomery, Montgomery, AL, 36117, U.S.A.

In 1993 we reported [J.R. Nanney, C.A.L. Mahaffy and A.K. Traylor, *J. Fluorine Chem.*, **64**, 217 (1993)] several mathematical models for the prediction of the ^{19}F NMR spectra for derivatives of fluorobenzene. One of the most precise was a 35 term quadratic model which used the Field ($\mathcal{F}$), Resonance ($\mathcal{R}$), and Charton's Steric (ν) parameters together with Molar Refractivity (MR) to predict the signal position. Although this was an excellent model for the prediction of the signal position, it required that the molecule be arbitrarily oriented before prediction of the signal. We have now shown that this arbitrary orientation is not necessary if a symmetrical prediction equation such as the one shown below is used.

$$\begin{aligned}\Delta^F = & 9.650\mathcal{F}_4 + 23.66\mathcal{R}_4 - 6.093\nu_4 + 0.4200MR_4 + 14.41(\mathcal{F}_2 + \mathcal{F}_6) \\ & + 116.7(\mathcal{R}_2\mathcal{R}_6) + 42.98(\nu_2 + \nu_6) - 3.478(MR_2 + MR_6) - 96.58(\mathcal{F}_2^2 + \mathcal{F}_6^2) \\ & + 39.25(\mathcal{R}_2^2 + \mathcal{R}_6^2) - 89.61(\nu_2^2 + \nu_6^2) - 0.1701(MR_2^2 + MR_6^2) + 62.46(\mathcal{F}_2\nu_2 + \mathcal{F}_6\nu_6) \\ & - 133.2(\mathcal{R}_2\nu_2 + \mathcal{R}_6\nu_6) - 2.662(\mathcal{R}_2MR_2 + \mathcal{R}_6MR_6) + 9.607(\nu_2MR_2 + \nu_6MR_6) - 112.9 \\ & [r = 0.98, s = 4.0, n = 839]\end{aligned}$$

This equation also has the advantage of having only 16 coefficients (plus the constant coefficient) with little or no loss in predictive ability when compared to the previous model.

This presentation will focus on the use of symmetrical mathematical models in the prediction of NMR line positions. Several other examples will also be presented.

THE PREDICTION OF NMR LINE POSITIONS BY STATISTICAL METHODS.

J.R. Nanney and R.E. Jetton, Department of Mathematics, C.A.L. Mahaffy, Department of Chemistry, Auburn University at Montgomery, Montgomery, AL, 36117, U.S.A.

There are three ways in which NMR line positions can be predicted by statistical methods: 1) Substituent Chemical Shift Values (SCS) 2) Statistical Substituent Chemical Shift Values (SSCS), and 3) Mathematical Modeling using known parameters for substituent groups.

To date, we have undertaken the following studies using SCS/SSCS values: ^{11}B NMR of trigonal boranes, ^{13}C NMR of the ring carbons in benzene derivatives and the ^{19}F NMR of fluorobenzene derivatives, fluoroethylenes, fluoro derivatives of pyridine and related systems and fluoroarenetricarbonylchromium complexes. Mathematical Modelling studies have been undertaken for the ^{11}B NMR of trigonal boranes, ^{13}C NMR of the ring carbons in benzene derivatives, ^{14}N NMR of ammonia derivatives and the ^{19}F NMR of fluorobenzene derivatives, fluoroethylenes, and fluoroarenetricarbonylchromium complexes.

The SSCS method has the advantage over the traditional SCS method in that values for a particular group in a particular position can generally be obtained if that group occurs somewhere in that position in the data base. This method does, however require large data bases in order to be effective. The Mathematical Modeling method has the advantage in that it can be employed on relatively small data bases and requires only that the substituent parameters (we have had success with the Field, Resonance and Charton's Steric Parameters together with Molar Refractivity) for the particular group in question be known. This presentation will discuss the relative merits of the SCS/SSCS and Mathematical Modeling techniques using examples from the above studies.

Abstracts

CHARACTERIZATION AND REACTIVITY OF Co(III)-CYCLEN COMPLEXES. Jill Rawlings and Vicki Sommerville, Dept of Chemistry, Auburn U. at Montgomery, Montgomery, AL 36117.

Co(III) complexes containing four nitrogen ligands have been found to be efficient catalysts for the hydrolysis of phosphomonoester complexes. However, unlike most other compounds, the Co(III)-cyclen compound can facilitate the hydrolysis of the phosphomonoester p-nitrophenylphosphate at neutral pH. In order to understand the mechanism of this reaction, the Co(III) complex with cyclen has been studied, using ^{31}P NMR, UV spectra, and analytical data. It is found that the active species is a dimer.

GEOLOGY

PETROGRAPHY AND LUMINESCENCE PROPERTIES OF DOLOMITE WITHIN THE SMACKOVER FORMATION, CORE X1533, ESCAMBIA COUNTY, ALABAMA. Mary Hall-Brown. Douglas W. Haywick, Geology & Geography, Univ. of S. Alabama Mobile, AL 36688 and David Kopaska-Merkel, Geological Survey of Alabama, Tuscaloosa, AL 35486.

Dolomite comprises a significant proportion of the oil-producing interval(s) in the Smackover Formation in Escambia County, Alabama. The dolomite is secondary and formed from diagenetic alteration of an earlier limestone. Replacement occasionally preserved the original texture of the precursor limestone and some algal components, notably oncoids, are distinguishable. Petrographically, this dolomite is medium-crystalline (250 to 500 μm), relatively turbid, anhedral, and is moderately bright red under cathodoluminescence. Chemical staining and luminescence petrography suggested that this dolomite would contain some manganese, but little iron. This was confirmed in a preliminary phase of electron microprobe analysis (Fe^{2+} : 0.04 wt%; Mn^{2+} : 0.09 wt%). The majority of dolomite within the core examined is not fabric-preserving. However, its luminescence and geochemistry is similar to the fabric-preserving variety and we therefore conclude that it is probably the same generation.

A second generation of dolomite is associated with pore-filling and fracturing. This dolomite is coarsely crystalline (> 500 μm), non-turbid, euhedral and zoned. Central portions and outer zones of dolomite rhombs are moderately to brightly luminescent and contained approximately 0.05 wt% Fe^{2+} and 0.15 wt% Mn^{2+} . A middle zone was enriched in both iron (approximately 1.0 wt%) and manganese (1.0 to 1.5 wt%). It was only weakly luminescent under cathodoluminescence.

Calcite cement is the youngest major diagenetic precipitate in the samples examined. It is variably luminescent and primarily fills fractures and intercrystalline void space among dolomite rhombs. This generation of calcite is associated with dedolomitization in other cores from the area (i.e., Appleton Field). Funding for this project was provided in part through a Gulf Coast Association of Geological Societies Student Grant.

Abstracts

SEDIMENT TEXTURE SIGNATURES IN GULF COAST ESTUARIES. Wayne C. Isphording, Dept. of Geology-Geography, Univ. of South Alabama, Mobile, AL 36688.

The northern Gulf of Mexico is fringed by numerous estuaries that act as traps for the great bulk of sediment eroded from the continental interior of the United States. The various watersheds that contribute sediment to these estuaries vary widely in terms of exposed strata, topography, and agricultural, municipal, and industrial land use patterns. As a consequence of this, suspended sediment and bottom sediment loads carried by the major rivers are markedly different, as are also river discharge rates, estuarine sediment accumulation rates, and the mineralogy of the bottom sediments deposited in each estuary. Further, the channelization of streams and construction of dams in some of the watersheds have further acted to modify both the quantities and textural properties of sediments transported by rivers to each estuary.

Sediment textural differences are plainly visible on sand-silt-clay ternary plots for sediments from each estuary. If plots of a bay's sediments are made for samples collected at different times, man's influence on some of the watersheds is clearly visible as are also the forces of nature. With respect to the latter, hurricane events have been clearly imprinted on the sediments of Apalachicola Bay (Florida), Mobile Bay (Alabama) and Barataria Bay (Louisiana). Other estuaries, such as Lake Pontchartrain (Louisiana), Perdido Bay (Alabama), and Pensacola Bay and Choctawhatchee Bay in Florida show little change (or only gradual changes) in sedimentation patterns over time. The unique morphology of these bays is partially responsible for the lack of storm signatures and the bays also reflect watersheds characterized by more subdued anthropogenic activity.

FORCED VERSUS UNFORCED REGRESSIONS IN THE ROCK RECORD: EXAMPLES FROM THE PLIO-PLEISTOCENE OF NORTH ISLAND NEW ZEALAND. Douglas W. Haywick. Depart. of Geology & Geography. Univ. of South Alabama. Mobile. AL 36688.

A forced regression is caused by a direct lowering in sea-level such as that accompanying glacial advance or tectonic uplift. The term was first introduced by Posamentier and others in the late 1980's as a means by which to distinguish "externally-driven" regressions from those generated through simple coastline progradation (normal regressions). Forced regressions generally result in sharp bounding surfaces between deep water (mid- to outer shelf) and shallow water (neritic) facies; however, stratal architecture is highly variable due to other factors (subsidence rate, sediment flux etc.).

The Petane Group is a mixed carbonate-siliciclastic sedimentary sequence outcropping in eastern North Island New Zealand. It is over 500 m thick and contains 5 distinct cyclothems. Each cyclothem contains a lower interval dominated by fine-grained sedimentary facies and an upper interval dominated by coarse-grained facies. Detailed sedimentological analysis has revealed that the upper coarse-grained interval of each cyclothem was deposited during sea-level lowstands. In comparison, fine-grained intervals of cyclothems were deposited primarily in middle to outer shelf sedimentary environments (50 to 150 m water depth). Each cyclothem therefore preserves a record of sedimentation during a relative sea-level rise, fall and stillstands. All initial relative sea-level rises are marked by sharp bounding surfaces. The record of sediment response to relative sea-level fall (regression) differs between the lower two and upper 3 cyclothems. The lower two cyclothems have gradational bounding surfaces between mid-shelf and shallow-marine facies indicative of normal regressions; however, these contacts are sharp and erosive in the upper three cyclothems. The upper three cyclothems therefore record forced regressions. Differences in sedimentation type (carbonate versus siliciclastic), sedimentation rate, and tectonism are thought responsible for the variation in the type of regression that is recorded in the Petane Group.

AQUIFER DEPLETION AND ALABAMA'S FIRST WATERSHED MANAGEMENT AUTHORITY. David C. Kopaska-Merkel, Geological Survey of Alabama, PO Box O, Tuscaloosa AL 35486.

The Choctawhatchee-Pea Rivers Watershed in southeast Alabama has plentiful ground-water resources, but several population centers are mining ground water. Public water-supply wells in areas exhibiting long-term linear water-level declines will, if trends continue, fail to produce water or suffer reduced water production within decades. Areas of excess pumpage characterized by declining water levels are found in all parts of the basin. Every aquifer exhibits some areas in which water levels are stable; most exhibit one or more local areas of significant water-level decline. The ground-water supply problems are local, but workable solutions must be planned at the watershed scale. For instance, the question of aquifer communication is one of the most-important unanswered questions pertaining to ground-water supply in the watershed. Solutions involve tapping aquifers where they are relatively unused, and controlling well spacing and pumping rates. In the absence of a comprehensive water-management plan, local ground-water supplies will fall short of water needs at Dothan, in western Dale County, and perhaps elsewhere in the watershed within the next century. In response to a variety of water-related problems, a local citizen's group was organized and later became a state agency. The Choctawhatchee-Pea Rivers Watershed Management Authority (CPRWMA) is the only watershed-scale water-management agency in Alabama. CPRWMA is working successfully with state and federal agencies toward development of a watershed management plan, and is a model of successful interagency cooperation in a climate of relaxed regulation. This model may be fruitfully applied elsewhere in Alabama and in other southern states. The research reported here was partially funded by CPRWMA.

DOLOMITE ALTERATION IN THE SMACKOVER FORMATION, APPLETON OIL FIELD, ESCAMBIA COUNTY, ALABAMA. Leigh Pfeiffer, Douglas W. Haywick, Depart. Geology & Geography, Univ. of South Alabama Mobile, AL 36688 and David Kopaska-Merkel, Geological Survey of Alabama, Tuscaloosa, AL 35486.

Dolomite alteration is a common diagenetic process in carbonate rocks. We have observed calcification ("de-dolomitization") of dolomite in an interval of core through the Smackover Formation in the Appleton Oil Field, Escambia County, Alabama. The de-dolomitization is blotchy, sporadic and in most instances, consists of small patches of calcite (10 to 50 μm in size), scattered within the dolomite crystals. We have not observed any preferential replacement of dolomite in this core (e.g., specific zones within crystals).

Significant etching has also occurred around the edges of dolomite rhombs in contact with late-stage pore and fracture-filling calcite suggesting that some de-dolomitization occurred following an episode of fracturing. The geochemistry of the dolomite, de-dolomite and fracture-filling calcite is presently being resolved through the use of electron microprobe analysis. Initial data suggest that the dolomite and de-dolomite are relatively uniform in terms of their trace element geochemistries (Fe^{2+} : 0.20 wt%; Mn^{2+} : 0.20 wt% and Fe^{2+} : 0.03 wt%; Mn^{2+} : 0.05 wt%, respectively), but that the geochemistry of the calcite void-filling cement is more variable, particularly with respect to Mn^{2+} (Fe^{2+} : 0.0 - 0.04 wt%; Mn^{2+} : 0.07 - 0.30 wt%). Cathodoluminescence suggests that there are multiple phases of calcite cementation in this core. The earliest phase is non-luminescent (low Mn^{2+}), but later phases are moderately luminescent (high Mn^{2+}) or contain many narrow zones (variable Mn^{2+}). The most luminescent calcite fills thin fractures that cut across both the dolomite and the other phases of calcite. Of the three calcite phases, only the earliest seems to be involved in de-dolomitization. This will be confirmed through additional luminescence petrography and electron microprobe analysis.

We thank the Gulf Coast Association of Geological Societies who provided the senior author with financial support to undertake this research project.

Abstracts

GEOOTHERMOBAROMETRIC ANALYSIS OF THE MURPHY BELT STRUCTURAL EVOLUTION, NORTH GEORGIA BLUE RIDGE. David T. Allison, Dept. of Geology, Univ. of South Ala., Mobile, AL 36688. Mark S. Groszos and James F. Tull, Florida State University, Tallahassee, FL 32306.

The Murphy belt (MB) of the western Blue Ridge contains the Murphy syncline (MS) a first generation, northwest overturned, doubly plunging, isoclinal fold extending for >170 km in Georgia and North Carolina. The MB contains metaclastic, metacarbonate and mafic metaigneous rocks of late Proterozoic to early (middle?) Paleozoic age. Metamorphic grade along the MS varies from upper greenschist facies (qtz+musc+chl+chld) to middle amphibolite facies (qtz+ms+bt+staur+ ky+grt). Mapping of first appearance of index minerals by previous studies show a general decrease in grade in map view from both fold limbs into the synclinal core. Samples collected during this study include transects both transverse and parallel to the MS. Pressure and temperature (P-T) estimates from these samples using the mineral assemblage grt+bt+pl+ms (GBPM) have yielded a T range of 572 - 631 °C and P range of 6.20 - 7.45 kb. Significantly, the P-T estimates define a geothermal gradient of 16°C per km, and fall within mineral stability fields consistent with petrographic observations. The array of P-T estimates in P-T space is enclosed by the field of low-to-middle amphibolite facies pelitic mineral assemblages, supporting the absence of any significant post-metamorphic tectonic discontinuities between sample locations in the study area. Based on the structural position of P-T estimates, and on metamorphic fabric relationships, we interpret the MS to be syn- to post-metamorphic. The structural position of late fold structures transverse to the MS can be correlated to local variations in P-T along the trace of the MS. Metamorphic isograd pre-fold position can be reconstructed from P-T data and structure.

MIDDLE TO LATE PALEOZOIC EXTENSIONAL DEVELOPMENT OF WEST-CENTRAL VESTVAGOY, NORTH NORWAY. Andre Klein and Mark G. Steltenpohl, Dept. of Geology, Auburn Univ., AL 38649-5305. The island of Vestvagoy, in the Lofoten archipelago, contains some of the westernmost exposures of far-traveled Caledonian thrust nappes and underlying Precambrian basement. The Lofoten archipelago is believed to have occupied a position at or near the Caledonian orogenic core. An area of west-central Vestvagoy was reinvestigated in the summer of 1995. A package of metasediments structurally overlying the basement, informally known as the Leknes Group, contains local top-to-the-west sense of shear indicators which is at odds with earlier workers' interpretations for east-directed thrusting. The Leknes Group was emplaced against the basement along an east-directed thrust, and our findings are that later west-directed extensional shears overprinted these thrust fabrics. Tops-west extension is mainly manifest in wide (ca. 1 km) ductile shear zones containing west-dipping extensional shear bands, west-verging rootless folds, and asymmetrical feldspar porphyroclasts. West-plunging, down-dip elongation lineations in the mylonitic foliation are interpreted to indicate the line of transport. A 200 meter thick zone of highly brecciated and silicified basement rock marks the northwestern margin of the Leknes Group and is interpreted as a late brittle normal fault.

Abstracts

SEDIMENTOLOGICAL AND PETROGRAPHIC EXAMINATION OF AN EXHUMED SOIL HORIZON, DAUPHIN ISLAND, ALABAMA. Mark English and Douglas W. Haywick, Department of Geology & Geography, Univ. of South Alabama, Mobile, AL 36688

The public beach at Dauphin Island has recently undergone extensive erosion exposing a soil profile due east of the fishing pier. The soil is laterally continuous over 300 m and consists of two distinct layers. The uppermost layer is 16 cm thick, gray-black in color and consists of carbonaceous, well sorted, medium sand (mean grain size, 300 μ m). The lower layer consists of yellow-brown, moderately sorted, medium sand. It is partially lithified, at least 25 cm thick and forms a prominent ledge along the beach. Petrographic examination and x-ray diffractometry of samples taken from the lower layer indicate that the lithification is primarily due to secondary limonite precipitation. Some kaolinite is also contained within layer two. Clay minerals are generally absent from the upper layer.

We believe that the upper layer of the soil exhumed at Dauphin Island corresponds to the 'A' horizon (zone of leaching) of a typical quartzose sand-derived soil. The lower layer represents the 'B' horizon (zone of accumulation). Limonite and kaolinite contained within the lower soil layer were probably derived through infiltration and oxidation of pore water as it passed downward from the soil's surface.

The significant amount of carbonaceous material within the upper soil layer was probably derived from a forest fire. This conclusion is supported by burned out stumps which are exposed in the surf zone of the public beach. The charred portion of the stumps is level with the upper (carbonaceous) soil layer. At this time it is not possible to date the soil horizon. The general appearance of the soil and the tree stumps associated with it suggest that the soil is relatively young (<1000 years). Carbon-14 dating of the stumps is presently underway to resolve the age of the wood and the soil profile.

THE CENTRAL ALABAMA EARTHQUAKE OF OCTOBER 18, 1916.

Lewis S. Dean, Geological Survey of Alabama, P. O. Box O, Tuscaloosa, AL 35486.

The strongest recorded earthquake with an epicenter in Alabama occurred in 1916 and had an intensity of VII on the modified Mercalli scale. Contemporary newspaper accounts from five states have been used to characterize the regional distribution and effects of this temblor. The approximate location of the epicenter was in the Valley and Ridge province of eastern Jefferson County and northern Shelby County and is associated with the southern Appalachian seismic zone which historically has produced mild shocks with little or no damage. This earthquake provided one of the earliest opportunities to gather information on the effects of a moderate shock to evaluate the nature of southern Appalachian seismicity.

In Birmingham, three distinct tremors were felt within a period of three minutes beginning at 4:04 pm, with the first shock being the most violent and sustained. The shock was felt as a "peculiar wave motion" with witnesses in buildings describing a "slight pitch, with the suggestion of a roll, while the buildings groaned and rattled." Property damage was reported as slight, with the only appreciable damage being several hundred chimneys that were cracked or toppled. Two slight aftershocks were felt at 11 pm on Oct. 18 and one aftershock was felt at 8:40 pm on Oct. 21. The main shock was also felt in the Piedmont province (Talladega, Opelika, Lineville, Wetumpka) and in the Valley and Ridge and Appalachian Plateaus provinces (Huntsville, Athens, Anniston). In the Coastal Plain, tremors were felt in Marion and Montgomery. In these cases the shock was felt at 4:04 pm and lasted two to three seconds. In Tuscaloosa, three distinct and very slight shocks were reported.

In Atlanta, Georgia, the first tremor was felt throughout the city at 4:05 pm with a second and milder shock felt at 4:06. Three distinct shocks were felt in Dalton, Georgia, and at least two shocks, lasting up to 6 seconds and occurring up to three minutes apart, were felt in Athens, Columbus, and Macon. Tremors were felt as far west as Augusta, and no appreciable damage was reported from any city.

Tremors from the earthquake were felt as far south as Toombsville, Mississippi. Slight shocks were also felt in Nashville and Chattanooga, Tennessee, and Louisville, Kentucky. The earthquake was detected by the Georgetown University seismograph station in Washington D.C. at 5:08 pm [eastern time zone] and had a duration of approximately three minutes.

Abstracts

OBSERVATIONS ON THE MANIPULATION OF SEDIMENT BY THE COLONIAL ZOANTHID PALYTHOA SPP. Stephanie Fisher, Department of Biology and Douglas W. Haywick, Depart. of Marine Sciences, Univ. of S. Alabama, Mobile, AL 36688 and Erich M. Mueller, Mote Marine Lab., Florida Keys Marine Research Center, Marathon, FL 33050.

Palythoa spp. are dominant colonial zoanthids inhabiting many shallow reef environments in the Florida Keys. These organisms form large mats that cover many square meters and they often play an important role in sediment retention on Florida Key Recfs. Their tissue contain significant amounts of fine carbonate detritus ($<250\text{ }\mu\text{m}$) frequently exceeding 30 wt% of dry tissue mass. For the past two years, we have maintained several colonies of Palythoa spp. in two reef aquaria at the University of South Alabama. We have recently begun to monitor the response of polyps to sudden sediment influxes. The polyps are very sensitive to external forces and quickly close when the colonies are bumped, touched or sprinkled with sediment. Within 1 to 3 minutes, polyps re-open, and if necessary, begin to shed sediment from their surfaces. Some sediment is sloughed out of the polyps probably through the action of cilia in the outer tissue layer. These particles are entrapped by mucus and form long strings that are removed from the colonies through wave action. This type of sediment shedding is common on reef environments of the Florida Keys and may be the natural process that polyps use when the rate of sediment flux onto their surfaces is low (i.e., this is a general "grooming" process). The response of polyps to a sudden, larger influx of sediment could be considered as different. After re-opening, polyps tilt in order to dump the sediment in one continuous mass from their interiors. Within 10 minutes, most of the sediment that fell onto the polyps is removed from the colony. Sediment between polyps is mostly removed, but at a much slower rate. The removal process is assisted by wave agitation.

We have also observed periodic tissue contraction of some Palythoa spp. colonies. It is possible that contraction aids in sediment assimilation by forcing particulate material deeper into the tissue. This hypothesis is presently being tested in a laboratory experiment.

GEOGRAPHY, FORESTRY, CONSERVATION, AND PLANNING

JEBEL ALI FREE ZONE: PAST, PRESENT AND FUTURE. Christy Willcutt and William R. Strong, Department of Geography, Univ. of North Alabama, UNA Box 5064, Florence, AL 35632.

The Jebel Ali Free Zone is one of two human-made objects that can be seen with the naked eye from space. Located in the Emirate of Dubai in the United Arab Emirates, Jebel Ali has grown to a size of 100 square kilometers in less than two decades providing 322,700 square meters of open storage space and containing the world's largest human-made port with 67 berths and 10 miles of container handling facilities. This article documents its origins in this Persian Gulf country, its physical infrastructure, and the geographic expansion of its economic activities from the local to the global scale.

THE ENVIRONMENTAL EFFECTS OF STRUCTURAL ADJUSTMENT PROGRAMS (SAP) IN WEST AFRICA Chukudi V. Izeogu, Ph. D. Dept. of Community Planning and Urban Studies, Alabama A&M University, Normal, AL 35762

Since the 1980s, many African countries have implemented structural adjustment policies (SAPs) in the areas of liberalization of markets, adjustment of exchange rates, and public sector reforms under the auspices of the International Monetary Fund and the World Bank in order to improve commodity exports to generate foreign exchange, increase incomes and promote socio-economic development. But, the SAPs also conflict with long term sustainable development objectives because of their environmental linkages. In Cote d'Ivoire, Ghana, Niger, Nigeria and Senegal, current environmental problems which arise from pressure on land resources due to rapid population increase, expansion of commercial cultivation and industrial development have been affected by SAPs in many ways. The burden of external debts faced by these countries intensified the need for foreign exchange and increased resource exploitation for export. Economic reforms increased prices and spurred production of food and cash crops. These gains have been achieved by expansion of logging and agricultural activities into forest and marginal lands, and exacerbated natural resource degradation by expanding sectors in which the environmental costs of production activities are not internalized. In the primary production sector, compensating for the loss of earning capability imposed by currency devaluation automatically involved increasing output and, in turn, increased exploitation of the natural resource base. Also, in the energy sector, devaluation and pricing reforms led to increased price of commercial fuels, and a shift in demand to fuelwood for cooking. The increased use of fuelwood has contributed to deforestation, land degradation and desertification in parts of the countries studied. Although SAP aimed at promoting economic growth and, in turn, reducing poverty, it has also exacerbated urban and rural poverty through public sector reforms with adverse effects on the environment. Achieving sustainable development in the case study countries will require a fundamental re-orientation of economic development policies towards enhancing environmental accountability in economic decision-making.

USING COLOR INFRARED PHOTOGRAPHY TO IDENTIFY KUDZU GROWTH IN EAST ALABAMA. David R. Hicks, Remote Possibilities, Inc., Auburn, AL 36831.

Kudzu (*Pueraria lobata*), a leguminous deciduous vine native to Japan and China diffused widely throughout the southeastern United States in the last 100 years, and is now considered a nuisance. Although the presence of Kudzu on both ground and trees is obvious, identification from high altitude photos is very elusive. This paper is part of an effort to detect, map, and eventually compute Kudzu areas in a pilot project area in East Alabama using high altitude aerial photography. The main objective was to identify Kudzu areas using 1:58,000 scale National High Altitude Photography Program (NHAP) Color IR (CIR) photos and 1:40,000 scale National Aerial Photography Program (NAPP) CIR photos covering three test site areas. In addition, 1:40,000 scale panchromatic NAPP photos are evaluated with respect to CIR photos of the same area. Acquisitions vary from February through April over a 1986-1993 timeframe. Kudzu areas were identified in the photo coverage area during field surveys and photos were interpreted to determine if Kudzu was identifiable from surrounding vegetative cover types. Study conclusions indicate that the 1:40,00 scale CIR NHAP photos were the most effective for Kudzu identification.

EFFECTS OF FORESTRY SITE PREPARATION METHODS ON SEED BANK DIVERSITY 36 YEARS POST-TREATMENT. Robert E. Prescott and Robert S. Boyd, Dept. of Botany and Microbiology, Auburn University, Auburn, Alabama 36849.

Maintaining biodiversity is increasingly becoming a priority of forest managers. This study, established in 1958, evaluated the impact of 6 site preparation methods on seed bank diversity. The site preparation methods included: injection with herbicide, axe frill and application of herbicide, chain frill and application of herbicide, foliar spray with herbicide, girdling, and bulldozing. The study site was located in Fayette County, Alabama. Seed bank diversity was assessed by removing soil cores from 2 depths (0-5 cm and 5-10 cm), spreading the cores in trays in a greenhouse, and allowing the seeds to germinate over a 7-month period. Existing plants were removed and the trays were stirred three times during the 7-month period to stimulate additional germination. Total seed bank size and diversity were not significantly affected by treatments and a similar result was observed for the deep soil layer. However, treatments significantly affected seed bank size and diversity in the uppermost soil layer. Seed bank size was highest for the bulldozer treatment while other treatments were relatively uniform. Seed bank diversity, as measured by the Shannon-Weiner Index, was highest for bulldozer and foliar herbicide treatments. We conclude that site preparation treatments can produce significant differences in forest soil seed banks.

Abstracts

VARIABILITY OF NICKEL HYPERACCUMULATION IN PSYCHOTRIA DOUARREI FROM NEW CALEDONIA. Robert S. Boyd, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849.

Plants with leaves that contain more than 1,000 ppm Ni on a dry weight basis are termed Ni hyperaccumulators. Variation in the levels of Ni in leaves of hyperaccumulating plants may have important implications for organisms feeding upon these plants, yet has rarely been quantified. The Ni hyperaccumulating shrub Psychotria douarrei, endemic to the South Pacific island of New Caledonia, was selected for this study because it has the highest foliar Ni levels recorded for any plant species. This study examined variation in Ni levels between individual plants and the effects of plant size and leaf age on foliar Ni values. Standard deviations of the mean Ni values of 14 shrubs varied 15-fold, indicating extremely high variation in Ni levels for leaves from different branches of an individual shrub. There was no linear relationship between plant size (as measured by stem cross-sectional area) and foliar Ni concentration. Leaf age significantly affected Ni content, with old leaves containing greater amounts of Ni than young or middle-aged leaves. These results show that Ni hyperaccumulation varies markedly between branches of a single shrub and is also strongly influenced by leaf age. This variation may affect the palatability of P. douarrei leaves to herbivores.

EFFECTS OF HERBICIDE SITE PREPARATION TREATMENTS ON FLORISTIC DIVERSITY IN CENTRAL GEORGIA. Anna E. Petty, Robert S. Boyd, and John D. Freeman, Dept. of Botany and Microbiology, Auburn Univ., AL 36849; and J. H. Miller, USDA Forest Service, Auburn Univ., AL 36849.

Maintenance of biodiversity is becoming a goal of forest management. This study assessed the effects of herbicide site preparation treatments on plant species diversity, richness, and structural development eleven years post-treatment. Four study sites were established in central Georgia. Each of these sites was separated into six plots, each treated with one of the following herbicides: Velpar L, Pronone 10G, Tordon 10K, Garlon 4, Banvel + Banvel 720, and Roundup. An untreated (check) plot was also established at each site. In 1995, the overstory (over 1.5 m height) layer was measured using stem counts. In the same year, the understory (under 1.5 m height) layer was measured by percent cover. ANOVA's were used to test for significance ($P < 0.05$) using a randomized complete block model. Treatments had no effect on total species richness. Species diversity, examined separately for overstory and understory layers, also was not significantly influenced by treatments. It was concluded that herbicide site preparation treatments did not decrease plant species richness or diversity eleven years after treatment.

Abstracts

REGIONAL SOCIO-ECONOMIC ANALYSIS OF ALABAMA: 1970-1990

Levert Winston, Terry Mercer and Chukudi V. Izeogu; Department of Community Planning and Urban Studies, Alabama A&M University, Normal, AL 35762

Alabama Association of Regional Councils consists of twelve regional planning and development districts which were created in 1969 by Act #1126 of the State Legislature to enable local governments come to grips with regional issues on a cooperative basis. Each regional council is charged with the responsibility of implementing area-wide planning programs, and assisting local and state agencies with needed coordination of plans and development programs. A comparative analysis of the regions' demographic and economic characteristics between 1970 and 1980, shows that about 50% experienced population growth. The percentage of population change in these regions ranged from 19.1% for South Alabama Regional Commission to 66.6% for Central Alabama Regional Planning and Development District. However, during the 1980-1990 decade, only 17 % experienced positive population change ranging from 18% to 22%. About 42% of the regions lost population. An examination of the 1980-1990 regional economy, defined in terms of total personal incomes, indicates that Birmingham, South Alabama and Top of Alabama regional councils experienced the highest growth: 156.4%, 159% and 146% respectively.. The positive economic outlook of these regions is reflected in the population gains they have made from 1970-1990. There are regional variations in development potentials, problems and need, as well as indicators of inequality in development within each region. In the North-Central region, for example, Culman county has well developed transportation infrastructure while Lawrence county has only US Highway 72 as the main transportation corridor. Also in the Top of Alabama region, Madison county continues to develop as the major growth center in the region while the other four counties have lagged behind. Promoting economic development in the stagnant and slow growing counties and regions is one way to minimize inter- and intra-regional development disparities in the state.

BANK STORAGE'S INFLUENCE ON GROUNDWATER FLOW IN THE SURFICIAL AQUIFER ADJACENT TO ESLAVA CREEK, MOBILE, ALABAMA. Daniel J. O'Donnell, P.G., Volkert Environmental Group, Inc., 3809 Moffett Road, Mobile, Alabama 36618. Acknowledgement is given to Dr. Douglas Haywick, University of South Alabama for his review of this paper and to Dr. Wayne Pettyjohn, Oklahoma State University, retired.

Groundwater measurements at shallow monitoring wells adjacent to Eslava Creek indicate bank storage of surface water run-off strongly influence the direction and rate of groundwater flow in the surficial aquifer. Potentiometric maps, constructed to evaluate flow direction and rate of flow, revealed three distinct flow patterns associated with rainfall events. Normal flow, characterized by low hydraulic gradients, occurs as groundwater flows towards and discharges to the creek. Recharge flow represents the period when the aquifer's potentiometric surface is influenced by bank storage. Recharge flow is characterized by steep hydraulic gradients and groundwater flow away from the creek. Transitional flow has flat gradients, flow neither towards nor away from the creek, and occurs briefly as flow shifts from recharge to normal flow. Due to the steeper gradients and longer duration of recharge flow, its influence on the direction of groundwater flow was dominant during the April 1995 period of study. Thorough evaluation of bank storage's influence on groundwater flow should be considered during groundwater investigations in similar hydrogeologic settings.

Abstracts

Murphy, Patrick B. and R.S. Boyd. Department of Botany and Microbiology, Auburn University, Al. 36849. Ecology of the Alabama Canebrake Pitcher Plant, *Sarracenia rubra* ssp. *alabamensis*

The Alabama canebrake pitcher plant is an endangered carnivorous plant found only in the Fall Line Hills of central Alabama. Virtually nothing is known about the basic biology or habitat requirements of this *Sarracenia* subspecies. Baseline ecological data on this plant can assist in conservation and recovery efforts. The more prominent habitat features of these pitcher plant bogs were the focus of this study. An attempt was made to identify the conditions under which this plant grows best. Each of the eleven sites was surveyed for associated species and an associated species index was calculated. Soil moisture was monitored for one year at three of the sites. Soil moisture values ranged from 8.2% to 42.7% in the bogs and 5.4% to 33.6% surrounding the bogs. Light measurements were taken during the growing season to determine relationships between shading and plant vigor. Soil samples were taken at each site and analyzed for: pH, organic matter, nitrogen, texture class, and mineral content. There was no significant correlation of any single habitat variable to plant health or site quality, although signs of etiolation were present at many of the shaded sites. The herbaceous associate species found at a site are the best indicators of site quality. The presence of many of the associated species suggest that the site is under less stress than a site without many associates. Perhaps the canebrake pitcher plant, an herbaceous perennial, is a more hearty species in its community than the annual herbs.

PHYSICS AND MATHEMATICS

ENERGY GAINS BY PROTONS MOVING NEAR THE DUSK FLANK OF THE MAGNETOSPHERE. B. J. Bateman, Dept. of Physical Science, Troy State University Troy, Alabama 36082. D.C. Delcourt, Centre d'Etudes des Environnements Terrestre et Planétaires, Saint -Maur-des Fossés, France. B.L. Giles and T.E. Moore Space Plasma Physics Branch, NASA Marshal Space Flight Center, Huntsville, Al 35812.

A computer code to determine the trajectories of protons moving in the Earth's magnetosphere equatorial plane near the dusk flank indicated that protons with energies of only a few eV would gain energies in excess of 10 keV. To determine if this energy gain is real or if it was due to non-physical causes such as numerical integration problems or improper magnetic and electric field model interactions was made. Moderate changes in integration steps (factors of four or less) indicated no change in the outcome. Model mismatches studies seem to indicated that they are not the cause. There now appears to be a strong possibility that the phenomena is real. Further studies are in progress.

Abstracts

TEMPORAL DEVELOPMENT OF THE UNA HOLLOW CATHODE DISCHARGE.

Antonino Carnevali and David Forester, Department of Physics and Earth Science, Univ. of N. Alabama, Florence, AL.

This hollow cathode experiment is in its second year of operation. We describe the experimental facility and report on recent results. Most of the data was collected in the pressure range from 500 to 1000 mTorr in Helium, corresponding to the left portion of the Paschen curve, with a pulse forming network supplying up to 7500 V. An external magnetic field has been added recently to collimate the discharge and prevent it from fanning out to the walls of the vacuum chamber. The typical discharge shows a first breakdown at high sustaining voltages and carrying approximately 100 mA of current followed by a second breakdown - the main discharge - with a current of over 300 A accompanied by the collapse of the interelectrode voltage and lasting 100 microseconds. The high current breakdown is characteristic of hollow cathode discharges and it is believed to be the result of an enhanced radial electric field in the hollow portion of the cathode. The time delay between the low current mode and the onset of the main discharge varies between a few microseconds to several milliseconds and depends strongly on the gas pressure as well as the applied voltage. Although this type of discharges has been studied for over seventy years, a detailed description of the behavior of the ionized gas during the evolution of the discharge has been elusive due to the wealth of physical processes involved.

COMPUTER SIMULATION OF PARTICLE ORBITS IN THE UNA HOLLOW CATHODE EXPERIMENT. David Forester, Cynthia Tidwell, and Antonino Carnevali, Department of Physics and Earth Science, Univ. of N. Alabama, Florence, AL.

As a first step in understanding the origin and development of the hollow cathode discharge, a particle orbit program has been built to describe the paths that electrons freed from the cathode with a spread of velocities would take when subject to the specific electric and magnetic fields associated with the experiment. The source of the electric field is the 7.5 kV potential difference between the cathode and anode. The potential distribution is calculated using a 3-D relaxation method in complex geometry. There are two contributions to the magnetic field included in the model. The first is the discharge current itself. To this is added the magnetic field produced by Helmholtz coils which acts to confine the discharge to a smaller cross-sectional area. The net B field is calculated using a Biot-Savart algorithm. With E and B defined, the force acting on the particle, and thus its acceleration, is known. Using a fourth order Runge-Kutta routine, the electron's trajectory is stepped in time until it hits a boundary surface. A preliminary comparison with experimental results, including both the low and high current regimes and with or without the external B field, will be presented.

Boundary Matrices For Ordinary Differential Systems. Anjali Datta, Department of Mathematics, Tuskegee University, Tuskegee, AL 36088.
Bonita A. Lawrence, Department of Mathematics, North Carolina Wesleyan College, Rocky Mount, NC 27804.

Solutions, $u(x)$ of the first order system,

$$u' = f(x),$$

satisfying multipoint boundary conditions,

$$\sum_{j=1}^k M_j u(x_j) = r,$$

are differentiated with respect to the entries of the matrices

$$M_j, \quad 1 \leq j \leq k,$$

where $M_1, \dots, M_k$ are $n \times n$ constant real matrices, $r \in \mathbb{R}^n$, and $x_1 < \dots < x_k$.

INDUSTRY AND ECONOMICS

ABSENTEEISM IN AN EDUCATIONAL SETTING. Henry M. Findley, Department of Marketing, Management, and Economics, Troy State University, Troy, AL 36082.

Study tested a modified model of employee attendance through regression at a major university library. Results indicate that attendance may also be dependent on educational status and co-worker satisfaction.

Abstracts

GUIDELINES FOR DEVELOPING STUDENT SPREADSHEETS. Jerry W. Ferry, Dept. of Accounting, Univ. of North Ala., Florence, AL 35632.

Spreadsheet effectiveness is determined by layout. This paper explains four standards and conventions that can be used to achieve the five spreadsheet criteria of (1) accuracy, (2) clarity, (3) flexibility, (4) efficiency, and (5) auditability.

INTERNET RESOURCES FOR BUSINESS RESEARCH. Paulette S. Alexander, T. Morris Jones, Department of Management, Marketing and Computer Information Systems, and Sarah R. Brown, Department of Accounting, University of North Alabama, Florence AL 35632.

How do university business faculty use the Internet? A recent survey showed that one in 11 Americans consider themselves to be Internet users. In contrast, a survey conducted for the present study revealed that three-fifths of university business faculty members use the Internet. Reasons for nonuse ranged from the "no time to use/learn" type of response to the "no value for me/students" type of response. The intent of this paper is to explore some of the primary reasons that faculty use the Internet and some of the types of activity that they find useful. The amount of time devoted to this activity is a concern of many--users and nonusers alike. Based on this study, two-thirds of faculty members devote an average of five hours or less per week to these activities. Primary uses of the Internet include E-mail and a variety of techniques for reaching distant computer sites and files. Also included in the presentation is a starter set of general internet sites and listserv addresses so that individuals who have little time to devote to learning but wish to get "on-line" can do so. The *Chronicle of Higher Education* recently reported that "the proliferation of internet sites is making it harder for investigators instead of easier." A recent study financed by the U.S. Department of Education indicated that university administrations do not know what benefits are being derived from the Internet use of their faculty and students. While this study only begins to answer that question, it does form the basis for additional research in that area.

For an e-mail copy of the full paper, please send an e-mail request to palexand@unanov.una.edu

USING THE WORLD WIDE WEB FOR ACCOUNTING RESEARCH.
Sarah R. Brown, Department of Accounting, T. Morris Jones and Paulette S. Alexander, Department of Management, Marketing and Computer Information Systems, University of North Alabama, Florence, AL 35632

With the coming of the Information Age there is a proliferation of information on all kinds of topics readily available on the Internet. Researchers need to be able to manage vast amounts of information in order to make it useful. Different tools have evolved for accessing information on the Internet, such as Telnet, File Transfer Protocol (FTP), Gopher, and the World Wide Web (WWW). Of these different types of access software, it is the World Wide Web, with its hypertext capabilities, that many users prefer. Accounting researchers can find vast amounts of detailed information if they know where to look. To get started, some specific sites with relevant accounting information are categorized here for tax research, auditing research, financial accounting research, governmental accounting research, and cost accounting research.

MARKETING HIGHER EDUCATION. Frederick A. Viohl, University, Troy State University, Troy, AL 36082.

Educational institutions operate within a complex and rapidly changing environment, which each institution must continuously monitor and adapt to if it is to survive and strengthen. The marketing environment has five components:

1. Internal Environment
2. Market Environment
3. Public Environment
4. Competitive Environment
5. Macroenvironment

The institutions that understand the above environments along with marketing principles often achieve their objectives more effectively. Proper incentives can motivate positive interaction to attract resources, motivate employees, and find customers.

Educational institutions recognize that various groups expect and need different things from them. Even small schools approach their students, alumni and other donors in different ways. They intuitively segment their constituents into relatively homogeneous subgroups, and they design offers to appeal to each key group or subgroup. Educational institutions can take three different approaches to a market. Mass marketing consists of mass-producing and mass distributing one program, or service and attempting to attract everyone to it. Product differentiation consists of producing two or more programs differentiated in style, features and quality to offer variety to the market and to distinguish the institution's offerings from those of competitors. Target marketing consists of segmentation, distinguishing the different groups that make up a market; targeting, selecting the most attractive segments; and positioning, developing an appropriate program and marketing mix for each target market.

Abstracts

USING AN ECONOMIC IMPACT STUDY AS A UNIVERSITY MARKETING TOOL. Gerald Crawford, College of Business, University of North Alabama, Florence, AL 35632

The University of North Alabama has found it very beneficial to conduct economic impact studies over the years. The first was completed in 1965 and subsequent studies were done in 1985, 1990, and 1995. The economic benefits of having a university in the area go far beyond the fiscal gross payroll. Direct expenditures by the University, faculty and staff, and students must be taken into consideration. Further, additional benefits result from the multiplier effect. This is a term that is widely used by economists to explain the total impact or chain of spending and respending that takes place when money is injected into an economy.

Direct economic impact on Colbert and Lauderdale Counties increased from \$3.8 million in 1965 to \$55.5 million in 1995, while total economic impact increased from \$9.5 million to \$122.2 million over this 30-year period. In the 1995 study it was shown that 5,171 jobs were created by the University of North Alabama through direct employment and through indirect effects of institution-related business activities. These studies have been used primarily as marketing tools to gain political support and cooperation from taxpayers, the local business community, and to attract resources at the state level. A press conference is held to gain favorable publicity along with related news releases, journal articles, presentations to civic clubs, and mailings to civic and political leaders across the state.

SOCIAL EXCHANGE AND DISTRIBUTIVE JUSTICE. Henry M. Findley, Department of Marketing, Management, and Economics, Troy State University, Troy, AL 36082. William F. Giles, Department of Management, College of Business, Auburn University, Auburn, AL 36831.

Study examined the influence of social exchange in procedural justice on distributive justice in the performance appraisal. Results indicate that social exchange in procedural justice does affect distributive justice attitudes with regard to the performance appraisal. The results were generally confirmed in a second study.

Abstracts

THE ALABAMA EMINENT SCHOLAR PROGRAM IN HIGHER EDUCATION AND COLLEGES OF BUSINESS. Regina Sherrill, and Gerald Crawford. College of Business, University of North Alabama, Florence, AL 35632

The Eminent Scholars Program originated in Alabama in 1985 with the passage of Act No. 85-759 by the state legislature. At that time, 14 institutions of higher education were eligible to participate. The University of North Alabama was one of those schools. The legislature recognized that "public universities in Alabama would be greatly strengthened by the addition of distinguished scholars serving as resident faculty members." A trust fund was established and the program was to be administered by the Alabama Commission on Higher Education. Each participating institution was required to raise (for each chair) a total of \$600,000 and this was matched by a state appropriation of \$400,000. The proceeds from the endowment were then used as salary or supplement for each eminent scholar chair holder.

The present research identified 13 eminent scholar chairs in colleges of business. Eleven of these chair holders were contacted and interviewed. Scholars were asked a series of questions relating to their backgrounds, teaching loads, travel, personal and institutional activities, and the primary focus of their work. All findings were reported in summary form, within the context of confidentiality, in the presentation.

ECONOMIC DEVELOPMENT OF TOGO: AN ANALYSIS OF EXPORTS AND ECONOMIC POLICY. Mindi Lamboni and Eric Rahimian, Department of Economics and Finance, School of Business, Alabama A & M University, Normal AL 35762

In recent years, the export promotion of primary-commodities has been used as a strategy to strengthen economic growth in some Sub-Saharan African countries. However, a central question in economic development hypotheses is whether expansion of primary-commodity exports in developing countries can be a significant factor for economic growth. This is especially important for African countries where the growth rate of economy is still lagging behind the growth rate of the population. In this paper, we use regression analysis to investigate the linkage between export promotion and economic growth in Togo. We find that Togo's exports of phosphate and agricultural products have positive coefficients, though they may not be statistically too significant. Also, the regression coefficient for the capital investment growth is both positive and statistically significant. Given the scarce resources of the Government of Togo, the export promotion policy may be oriented to factors that contribute more positively to economic growth. Our policy recommendation is to promote any exportable items, primary or manufactured, in which Togo can develop its comparative advantage. Examples of such products are cotton, spices and other nontraditional agricultural products. The improvement in labor productivity, efficient allocation of capital resources, good management of export sector, and the development of small enterprises in agribusiness must be encouraged.

Abstracts

MANAGING CONTINUOUS IMPROVEMENT IN THE PRODUCTION/OPERATIONS FUNCTION. Emeka Samuel Dunu, Department of Business Administration, Alabama A & M University, Normal, AL 35762.

Customers are increasingly demanding best values, which include variety of high quality goods and services that meet their needs at competitive prices. These values are largely the direct outcomes of the production/operations function, which has the vital responsibility of producing the goods and services a firm offers its customers. The dynamic nature of customers' needs and desires, coupled with an increasingly competitive marketplace, demand that the production/operations function continuously improve its processes, to ensure the provision of these values.

The challenge facing many manufacturing and service organizations is, instituting and managing the commitment to continuous improvement. To successfully do this, the production/operations function should;

1. Keep a constant focus on the needs and expectations of customers. There must be a systematic information gathering mechanism to evaluate customer satisfaction and needs, and the competition in the marketplace.
2. Encourage and demand the involvement of all employees in defining responsibilities, goals and requirements, through team approach.
3. Encourage all employees to engage in continuous learning and training tailored towards improving and diversifying their skills.
4. Encourage employees to continuously review and challenge the status quo in all activities that affect the production of goods and services. The goal should be to improve quality, cycle time, and overall operational performance.
5. Reward and compliment the teams for their improvements and contributions.

THE IMPACT OF ENTERING THE EUROPEAN CUSTOMS UNION ON THE TURKISH ECONOMY. Eric Rahimian and Yilmaz Esensoy. Dept. of Economics and Finance, Alabama A&M University, Normal, Alabama 35762

Turkey was seeking the membership in the European Customs Union for a long time and achieved its goal on January 1, 1996. During the last decade Turkey has experienced a reasonably good but widely fluctuating economic growth rate. The membership is expected to create a short-run economic discomfort and a long-run and dynamic growth rate for Turkey. In this paper we have studied the impact of the membership on different sectors of Turkish economy. Briefly, the textile, ceramic, construction, processed food, chemical and tourism industries are expected to benefit greatly from the membership. Local auto manufactures, appliance firms and domestic grocery and hardware stores will face harsher competition and will be forced to merge with larger firms, possibly the ones from EU, to enhance their survival chance. Overall, the early benefits of the membership in the European Customs Union may not be achieved without some concrete policy actions by the Turkish Government. The Government of Turkey needs to put its macroeconomic house in order. Inflation and exchange rates should be monitored and public debt needs to be reduced. Targeted fiscal policy may be used to reduce the short-run economic discomfort in affected sectors. Government leadership in creating social and political stability, privatization and conversion of economic activity for the larger market is essential for initiating good economic growth.

Abstracts

THE METAPHORIC ROLE OF "WELFARE REFORM." James G. Alexander and Marsha D. Griffin, Alabama A&M University, Normal, AL 35762.

In a period of economic polarization and social fragmentation, issues of near-universal agreement stand out. One of few such issues in the United States, mid 1990s, is the need for welfare reform. Welfare reform itself remains elusive, in part due to the magnitude and complexity of the undertaking, but also in part due to the metaphoric role assigned to welfare reform in contemporary political rhetoric. "Welfare," while usually left programmatically undefined, has become a widely acknowledged source of a plethora of problems. Most discussions of welfare implicitly focus on Aid to Families with Dependent Children (AFDC), and structural flaws in that program are recited as deleterious both to society-at-large and to welfare recipients. The fact that analysts of diverse perspectives and socio-political philosophies agree that the program is in need of major reform, however, leaves AFDC-as-is virtually without defenders. In public discussion, other support and safety net programs tend to be attached indiscriminately to AFDC as if they shared its characteristics and merely provided in combination a truer reflection of welfare's magnitude. Political interest in welfare reform has been heightened by recent notable increases in welfare needs. As social metaphor, the welfare system--at least as seen by its most ardent critics--corrodes character, feeds on (consumes) freedom, expands expenditures and "busts" budgets of government, and erodes the economy: it is the destructive beast. The welfare metaphor easily suggests the popular metaphor for welfare reform: the slaying of the beast. This construct presents two major problems. First, it effectively ignores the needs welfare programs are meant to serve. This is especially problematic given the increasing income inequality, insecurity, and poverty since the 1970s. Second, it complicates the making of social policy itself by obscuring paths to effective welfare reform and by reinforcing resistance to changes in non-welfare policies. The metaphoric role has created a mirage: a vast pool of budget savings available for Pareto-optimal drainage. But this is a mirage.

RETAIL PRICE COMPETITIVENESS FOR CONVENIENCE, SHOPPING AND SPECIALTY STORE LOCATIONS. Keith Absher, Kerry Gatlin and Donna Yancey, Department of Marketing, Univ. N. Al., Florence, Al. 35631.

This paper reviews the literature on pricing practices in retailing and extends the literature as a result of a survey of 415 retail store managers in five Southeastern states. The purpose of the research is to test retail store competitiveness along three lines: (1) Is retail store competition influenced by type of retail store; (2) Is retail store competition influenced by retail store location; and (3) Is competitiveness extended to include customer service as a component of price competitiveness? Based on the results of this research, stores categorized as 'shopping stores' placed the greatest emphasis on price. Surprisingly, convenience stores were next followed by specialty stores. In terms of location, the highest degree of price competitiveness was found in stores located in community shopping centers, followed by neighborhood shopping centers, free standing locations, regional shopping malls and the central business district, respectively. An emphasis on customer service was not automatically indicated for the less competitive types and/or locations, indicating a need for retail store managers to consider service as a strategic weapon to off-set price competition.

Abstracts

DISPARATE SCENARIOS FOR BALANCED-BUDGET ECONOMICS. James G. Alexander, Department of Economics and Finance, and Marsha D. Griffin, Department of Marketing, Alabama A&M University, Normal, AL 35762.

Macroeconomists, notwithstanding the philosophical diversity and intellectual heterogeneity which now characterize their field, generally recognize that balancing the federal budget is not an economic imperative. However, economics aside, there has come to be considerable political pressure toward a balanced-budget emphasis in economic policy-making. Moreover, many economists do contend that deficit reduction could contribute to improved economic performance, largely by facilitating financial adjustments conducive to secular economic expansion. The high real interest rates of the past decade-and-a-half cannot be attributed solely to the greatly enlarged federal deficits of this era, and therefore cannot be expected to be returned to historic levels by budget control alone. Nevertheless, it is important to recognize that the regime of high-cost financial capital has been instrumental in two of the economically defining phenomena of the period: relatively slow economic growth and increasing income inequality. To the extent that balanced-budget economics can serve to reduce interest rates, some of the troubling economic trends might be ameliorated or reversed. Little consideration has been given, however, to the disparate scenarios which can be projected as possible results of the advent of balanced-budget economics if such a policy approach does prevail. At least three scenarios deserve consideration. First is the possibility that a diehard laissez-faire approach might be employed, with the near certain consequence of short-run recessionary impacts and at best highly speculative long-run results. Second, a balanced-budget economic policy could lead--contrary to the expectations of its strongest supporters--to an expanded governmental sector. By reducing the size of the multiplier, attainment of a given fiscal stimulus could require a larger rather than smaller government. The third scenario is perhaps the most likely: a policy-mix change favoring easier monetary policy and a regime of lower interest rates encouraged by accommodating Fed policies.

ATTITUDES TOWARD BLOOD DONATION AMONG COLLEGE STUDENTS.

Brad Coan, Julie Briles, and Jennyfer Imanuel. College of Business, University of North Alabama, Florence, AL 35632

The American Red Cross asked the Ad Club at the University of North Alabama to conduct research that could be used to develop an effective ad campaign to promote blood donations among college students. The objective was to determine why the percentage of blood donations from college students was lower than among the general population.

A sample of 403 students was scientifically selected from the student body of 5437 during the Fall Semester of 1995. The questionnaire included 27 statements about blood donation. Respondents were asked to what degree they agreed or disagreed with each statement using a Likert Scale format. Through the use of Factor Analysis, the study identified seven distinct groups of factors relating to attitudes held. Students labeled and ranked each factor group based on size of variance explained in the analysis. These groups were named "Care Givers," "Material Donors," "Recognition Seekers," "I Would If," "Safety Group," "Life Savers," "Busy Bodies." Findings of the research, from most important reason to give to least important were (1) to benefit others, (2) to receive something in return, (3) to receive recognition, (4) medical prohibitions, (5) safety questions, (6) to save a life, (7) insufficient time.

Abstracts

HUMAN DEVELOPMENT AND GENDER INEQUALITY: A COMPARATIVE STUDY OF DEVELOPED AND DEVELOPING COUNTRIES. Mohammad G. Robbani and Eric N. Rahimian, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762.

Gender equality is an important component of human and economic development. After tackling the issue of human rights for several decades, the sub-organizations of the United Nations and the world as a whole have started paying more attention to the question of gender inequality. In this paper, we study and analyze the disparity of income, education, occupational employment, and health profiles of the two genders for two sets of countries - developed and developing nations. The developed countries selected are Canada, France, Japan, Germany, and the United States and the developing nations selected are Bangladesh, China, India, Indonesia, Pakistan, Philippines, and Sri Lanka. The analysis shows that there has been a considerable progress in the women education and health care over the last two decades. That means the disparity in these areas between men and women has narrowed remarkably in most of the countries. However, there still exists a tremendous economic disparity between the two genders. This economic disparity is not only because of the fact that women are not given the opportunity to progress but also because of the fact that a large portion of the activities performed by women are unaccounted for or undervalued. There is also some evidence that the disparity is not only concentrated in developing countries but is also noticed and widespread in developed nations. This indicates that income, though an important factor, is not the only reason for disparity. Literacy and culture also seem to be important factors for gender-related disparity. Therefore, education and political leadership are required to modify the social norms and to produce a sustainable corrective policies to eliminate inequality.

HEALTH CARE PROBLEMS AND SOLUTIONS IN THE UNITED STATES. Terry Carter and Eric Rahimian, Dept. of Economics and Finance, School of Business, Alabama A&M University, Normal, Alabama 35762.

Every one agrees that the lack of a universal health care coverage has become problematic in the U.S. For the last few decades health care costs have increased at a rate of about 11.5% a year. The fundamental flaws in the U.S. health care services market imply that consumers are paying much more than the cost of the services provided. Apart from South Africa, the U.S., even though has the largest per capita health care cost, is the only other industrial country in the world that does not have a program to guarantee health care coverage for all its citizens. In this paper, we have reviewed the current and proposed health care plans and have made some recommendations to bring about a universal health care system. Briefly, President Clinton's health care reform proposal sought to build on the managed care concept to achieve universal coverage for every American. There also has been at least two other health care plans discussed by the Congress which we have reviewed. The current health care programs include Medicare, Medicaid, Federal Employee Health Benefits, and Veterans' Health Care Benefits. There are several policy options including universal coverage, employer-based plans, market reforms, tax system options, and expanded public programs. It is obvious that the U.S. Government should feel some obligation to develop a plan to eliminate this deficiency which has some impacts on the welfare and economic growth of our nation. Americans do not need to reinvent the wheel. We can adopt some of the measures developed by other nations and add a few of our own to create a universal health care system which makes us proud.

Abstracts

UPDATE ON DIRECT RESPONSE TV. Keith Absher and Kerry Gatlin, Dept. of Marketing and Management, Univ. of North Alabama, Florence, AL 35632.

When the Federal Trade Commission eased commercial air time restriction in 1984, it inadvertently opened the door to direct response TV, the fastest growing marketing arena for many products of the past decade. Compared to other marketing categories, sales from direct response TV have been unprecedented, not always in sheer volume, but in growth. Direct response TV is often called "electronic retailing." However direct response TV can no longer be judged by the sleazeballs in it. Many of the upscale fortune 500 companies are now considering direct response TV as a viable way of reaching their customers.

In 1994 infomercial generated over \$1 billion in product sales, and the future could grow by 50% a year. Direct Response TV takes Three forms: Short form commercials (two minutes or less in duration, usually used to sell recordings, magazine subscriptions, books, etc.), Infomercials (program-length advertising for product or service) and Home shopping channels.

People who buy from direct response TV are younger and more active than conventional wisdom might suggest. Almost half (48 percent) of regular TV shoppers are aged 25 to 44, compared with a sample average of 45 percent. TV shoppers are less likely than average to be married, elderly, or employed in a professional job. They are more likely than average to be blue-collar workers, homemakers, and salespersons. And 37 percent of TV shoppers are black or Hispanic, compared with a market average of 22 percent.

TV shoppers are a diverse group, concentrated at the lower and upper ends of the income scale. In other words, their median household income is lower than average, but people with incomes of more than \$75,000 a year have an average probability of being TV shoppers. TV shoppers are also trend-conscious. They are more likely than average to own and use home technology such as VCRs and cellular phones, and they are more likely to look for "familiar labels" and "the latest styles" when they shop for clothes.

GATT : PROGRESS AND CHALLENGES. Manuel Pinheiro and Eric Rahimian, Dept. of Economics and Finance, School of Business, Alabama A&M University, Normal, AL 35762.

The General Agreement on Tariffs and Trade (GATT) has made continuous progress to liberalize the trade between its members. In this paper, we study the recent progress of the General Agreement on Tariffs and Trade, and the challenges that the world Trade Organization (WTO), the successor of GATT, is facing in present global business environment. The Uruguay Round was an achievement for the world, and has substantially improved the prospects for restoring the credibility of multilateral trade systems on facilitating commerce and promoting economic development. Since the current specialization pattern in the world is mostly developed based on the principle of comparative advantage, it is important to assure that the progress toward trade liberalization is not hampered with protectionist measures again. Hence, international trade must be regulated by rules established by regional, multilateral, and global organizations which have promoted the present specialization scheme. The Uruguay Round has succeeded in admirable tariff reductions, further liberalization of trade by preventing other kinds of protectionist measures, and establishment of a stronger dispute settlement process under the supervision of WTO. The main challenges for WTO are avoidance of national treatment on investments, establishing the compatibility of free trade and environmental concerns, inclusion of all services trade, and the defence of intellectual properties. In addition, the WTO needs to make some provisions to help the former centrally planned economies of the Eastern Europe and the Newly Independent States of the former Soviet Union to join the global free market system. Overall, WTO may be considered as a worldwide system which can resolve the conflicts between the nations as well as the trade blocks, NAFTA, E.U. South East Asian Countries. and others in the twenty first century.

Abstracts

BENCHMARKING: CONSIDERATIONS, PROCEDURES AND IMPACT ON COMPETITIVENESS. Emeka Samuel Dunu and Lolita Howard, Department of Business Administration, Alabama A & M University, Normal, AL 35762.

Benchmarking has become a common practice among many leading firms. Through benchmarking, an organization discovers its strengths and weaknesses as it measures its products and procedures against the best world standards. Through this process, the organization learns and incorporates the best standards into its own products and practices in order to improve its competitive performance.

The first step in the benchmarking process is to identify what are to be benchmarked. Items to be benchmarked include performance characteristics of products and services, work processes, and business strategies. Once the items to be benchmarked have been selected, the next step is to identify benchmarking partner, followed by information gathering on current performances and performance gap. Then a plan to attain the identified superior performance level should be developed. Finally, implement the plan, monitor improvements and update benchmarks.

When embarking on a benchmarking effort, the following issues should be considered:

1. The benefits gained from a benchmarking effort must justify the cost of the effort.
2. Detailed understanding and assessment of internal practices must be completed before making comparisons against the best standards.
3. Employees who are involved in the benchmarking project should be those who will actually implement the new practices.
4. The items to be benchmarked should be prioritized and the team should not undertake more than it can handle at a time.

BLACK PATRONAGE OF AND ATTITUDES TOWARD BLACK-OWNED/MANAGED BUSINESSES: A PRELIMINARY STUDY. Marsha D. Griffin, Department of Marketing, and James G. Alexander, Department of Economics and Finance, Alabama A&M University, Normal, AL 35762.

During the Spring of 1996, 230 black consumers in Huntsville, AL, were interviewed to determine their patronage habits of and attitudes toward black-owned/managed businesses. Respondents were most likely to feel patronizing a black-owned/managed establishment was either very important or somewhat important for barber shops/beauty salons (90%), churches (89%), universities (85%), funeral homes (74%), beauty supply stores (73%), night clubs (73%), medical doctors (71%), and record stores (70%). They were least likely to consider ethnicity of owners/managers for picture framing shops (29%), hotels/motels (27%), printers/copy shops (26%), pawn shops (25%), and pet stores (16%). Eighty-two percent of the sample either strongly agreed or agreed somewhat that they would patronize more black owned/managed businesses if the businesses were located closer to them. Fifty-one percent either strongly agreed or agreed somewhat that they would be more likely to buy from a black-owned/managed business if it was located in a prestigious shopping center. Seventy-one percent either strongly agreed or agreed somewhat that a wider product selection would increase their patronage of black-owned/managed businesses. The majority of the respondents strongly agreed or agreed somewhat that product quality of black/owned-managed businesses was comparable to that of their white counterparts, prices were generally higher, customer service was similar, and the probability of fulfillment of contracts was about the same (73%, 62%, 67%, and 54%, respectively).

Abstracts

BENEFITS TO STUDENTS IN WORKING ON SMALL BUSINESS CASES.
Terrell Stewart, Ron Clark, and Gerald Crawford, College of
Business, University of North Alabama, Florence, AL 35632

The Small Business Institute (SBI) is the name given to a program designed to help small firms compete, or simply to survive. This Program is administered by the U.S. Small Business Administration (SBA) and involves more than 500 four-year colleges or universities. The program was established in 1972 and currently assists more than 7,000 small businesses each year. This cooperative program makes use of upper level or graduate students under the direction of faculty advisors to provide free consulting to small businesses. Teams conduct in-depth analyses for individual businesses and present written and oral reports that provide operational or managerial alternatives and recommendations.

An evaluation of the SBI program was conducted in 1994 in Alabama. It concluded that the SBI program was very successful. Almost half the respondents reported that their profits had been enhanced as a result of the assistance. The numbers of jobs saved and numbers of jobs created were also impressive. The present research, however, was done to examine whether or not graduate students benefitted from working on the case. Telephone interviews were conducted among a population of recent graduates. Ninety-two percent of the respondents had favorable comments about the experience. Other suggestions were provided that will help administrators to make changes and improvements in the course.

SCIENCE EDUCATION

PEDAGOGY: WHAT SHOULD BE EXPECTED OF NON-MAJORS BIOLOGY COURSES? John C. Frandsen & Helen H. Benford, Dept. of Biology, Tuskegee Univ., Tuskegee, AL 36088.

Non-majors general biology courses (NMGBC) must be tailored to the informational needs and cognitive development of students who are unlikely to be scientists; may well educate their children at home; will be primarily responsible for determining the attitudes toward science, science education, stewardship of our planet, and intellectual enterprises in general of the next generation of children; will be the movers & shakers of society; and will likely never again study anything biological in sufficient depth to modify or change the concepts they carry with them from college. These courses must accordingly provide an appreciation of what it is like to be a scientist, and of the importance of science as a human endeavor; familiarity with the scientific method; a realization of the uncertainties in biological "knowledge"; proficiency in accessing the biological literature; a classroom environment conducive to learning; and subject matter essential to future needs. Essential subject matter includes the scientific evidence supporting the theory of organic evolution; human ecology & proper stewardship of the planet; the biological bases of human behavior; the structure & functions of the human body in health and disease; an introduction to genetics, including genetic diseases; and present and future issues in biological ethics. The advantages of a modular approach to NMGBC instruction are presented. Development of this modular instruction is supported by National Science Foundation Grant DUE-9354628.

Abstracts

SIX TYPES OF LABORATORY INVOLVEMENT FOR MIDDLE SCHOOL SCIENCE. Ernest D. Riggsby, Dept. of Curr. & Inst., Joseph D. George, Dept. of Couns. & Clin. Progs., Dutchie S. Riggsby, Dept. of Edu. Tech., Adm. & Fnds. Columbus College, Columbus, GA 31907-5645.

To help to improve laboratory endeavors in middle school science, our team designed a series of selected laboratory work oriented studies, efforts, and projects. While all were oriented to six standard types of laboratory work, several were produced in different versions to stimulate interest and to motivate students to engage in discovery through both individual and group effort. The six standard laboratory approaches utilized were: Experiment, Activity, Demonstration, Open-ended Activity, Controlled Experiment, and Investigation.

SETI - TEACHING SCIENCE WITH A SINGLE EQUATION. Dail W. Mullins, Jr., Dept. of Curriculum & Instruction, University of Alabama at Birmingham, Birmingham, AL 35294.

In Sept, 1959, two astrophysicists at Cornell, Guiseppi Cocconi and Philip Morrison, published a brief article in the British journal Nature titled "Searching for Interstellar Communications." Almost overnight, it seemed, the fanciful subject of intelligent life on other planets was snatched from the minds of science fiction writers and Hollywood producers and brought into the "cold, hard light" of modern science. Thirty-seven years later, astronomers and physicists--now joined by the ranks of biologists, biochemists, earth scientists, social scientists and philosophers--are still debating the feasibility and practicality of SETI (the Search for Extraterrestrial Intelligence)

Precisely because it incorporates so many diverse fields of modern science, the subject of SETI--and especially the now-famous Drake Equation for estimating the number of communicative civilizations in the Galaxy--provides an almost unequalled opportunity to teach a variety of science topics and concepts within the interdisciplinary format of a theme which many students find irresistibly fascinating: the possibility of intelligent life on other planets. This paper will describe the organization and instruction of a one-semester, three-hour, Honors seminar on SETI for non-science majors.

Abstracts

A FLOW CHART FOR NAMING ACIDS, SALTS, AND COVALENT COMPOUNDS. Larry E. Gerdorn, Department of Natural Science, University of Mobile, Mobile, AL 36663-0220.

A flow chart for naming compounds will be presented. This approach to naming compounds allows students to quickly learn the principles involved in naming compounds. The classification of compounds is inherent in the structure of the flow chart and students use a periodic table of the elements along with a list of anions to formulate the IUPAC names for salts, acids, and covalent compounds. Eight examples will be demonstrated using the flow chart.

ADAPTATIONS FOR CHILDREN WITH DISABILITIES. Joseph D. George, Dept. of Counseling and Clinical Programs, Columbus College, Columbus, Ga. 31907. Ernest Riggsby and Dutchie Riggsby, Dept. of Curriculum and Instruction and Dept. of Foundations, Columbus, College, Columbus, Ga. 31907.

Children with disabilities are able to participate in regular education programs of science when certain modifications are made in teaching approaches. This paper discusses these modifications and highlights the characteristics of the children whom they would benefit.

ACT TEST SCORES CORRELATED WITH GRADES IN HUMAN ANATOMY AND PHYSIOLOGY. Elizabeth I. French, Dept. of Natural Sciences, Univ. of Mobile, Mobile, AL 36663.

ACT Scores (enhanced ACT assessment) were obtained for 233 students who completed Human Anatomy and Physiology courses at a medium-sized private university, 1990-94. Pearson product-moment correlation coefficients were calculated between numerical course grades and each of the four ACT subtests and the composite ACT score. Positive correlations were found as follows: English, .44; math, .33; reading, .35; scientific reasoning, .38; composite, .46. These figures were each significant beyond the .05 level. The data suggest that the student who has attained proficiency in the mechanics of English or, to a slightly lesser degree, has developed skills in math, reading or scientific reasoning, is somewhat better able to make a good grade in Human Anatomy and Physiology as taught at that particular institution. This research was supported by the Research Committee at the University of Mobile.

Abstracts

INSTRUCTIONAL MODULE FOR NONMAJORS GENERAL BIOLOGY: MIND, BRAIN, AND BEHAVIOR. Helen H. Benford & John C. Frandsen, Department of Biology, Tuskegee Univ., Tuskegee, AL 36088.

This pilot instructional module is part of an effort to develop for use in nonmajors biology courses materials and strategies that will produce college graduates with the knowledge, skills, and interest to deal with biological issues. The module is planned as a stand-alone unit readily exportable in whole or in parts. Each of the six module components targets particular skills or attitudes; all are designed to foster critical thinking, interpretive ability, independent learning, and appreciation of biological science. The first component, three case descriptions of patients with mental/behavioral disorders, captures student interest, sets the stage for an introduction to brain anatomy, and focuses on the mind/brain connection with its legal, ethical, and cultural implications. In the second module component, students characterize a mood disorder through stepwise analysis of graphs and diagrams. This activity provides practice in interpreting graphical data, performing arithmetical operations, drawing conclusions, and critiquing evidence. It also focuses on synaptic function from a clinical perspective. Drugs and the synapse also appear in another activity, a reading tracing the history of opiate use and highlighting economic, political, medical, and cultural aspects of this long history. Understanding of synaptic function as well as of the nature of scientific investigation is emphasized during an activity in which students are presented several tools with which to design an experiment that might shed light on the biochemical nature of a behavioral disorder recently described in some families. An article from a weekly news journal introduces students to the cutting-edge topic of mapping brain activity via scanning techniques and to some changing views of brain function arising from this technology. Students evaluate the popular press as a source of information on scientific issues. In a bibliographic assignment, each student uses electronic databases to identify research and popular articles on a different neuroscience-related question. Student attitude toward this module is generally positive. Further assessment will be needed to judge its long-term effectiveness. (This material is based on work supported by the National Science Foundation under Grant No. DUE-9354628.)

BEHAVIORAL AND SOCIAL SCIENCES

COMPUTERS, SEX AND FREEDOM VERSUS CENSORSHIP. Lyle L. Shook, Dept. of Justice and Public Safety, Auburn Univ. at Montgomery, Montgomery, AL 36117.

A look at government expansion of censorship by using the shield of child protection.

Abstracts

RULEMAKING UNDER THE FAMILY AND MEDICAL LEAVE ACT. Robert J. Van Der Velde, Dept. of Justice & Public Safety, Auburn Univ. at Montgomery, Montgomery, AL 36117.

The Family and Medical Leave Act is a relatively straightforward piece of legislation, providing for up to 12 weeks unpaid leave for many American workers. The process of promulgating rules for implementation of the Act, however, demonstrates to students the complexities involved in any piece of legislation, and is a valuable tool for teaching statutory interpretation as well as administrative procedure. This paper reviews the major provisions of the Act, sets forth several issues for students to consider in development of their own proposed regulations for implementing the Act, and examines the first published decision under the Act and its new regulations.

Coping with computer stress. Richard A. Hudiburg, Dept. of Psychology, Univ. of North Alabama, Florence, AL and James R. Necessary, Ball State Univ., Muncie, IN.

This research investigated coping strategies used by computer users who experienced varying degrees of computer stress. A research questionnaire was constructed and given to 90 students (83 provided complete replies) enrolled in college courses where computers use was part of the course requirements. The questionnaire contained questions about computer use information, ratings of computer knowledge and abilities (self-rating, and Computer Self-Efficacy Scale), the Computer Hassles Scale (a measure of computer stress), measures of somatization and anxiety (SCL-90), and Rosenberger's Self-Esteem Scale. The participants were asked to describe and rate the stressfulness of a computer problem and to complete the Ways of Coping Scale (a measure of coping strategies). A Severity of Hassles score was determined for each participant from the Computer Hassles Scale. The Severity of Hassles score was used to identify high-computer stress users and low-computer stress users. Within the range of the research participant's Severity of Hassles scores, high-computer stress users were those who scored in the upper 25% of the range and low-computer stress users were those who scored in the lower 25% of the range.

Statistical analyses of differences between high-computer stress users and low-computer stress users revealed that high-computer stress users had lower self-rated computer abilities, lower self-esteem, and reported higher levels of somatization and anxiety. High-computer stress users, in contrast to low-computer stress users, significantly employed at higher levels confrontive, self-controlling, accepting responsibility, and positive reappraisal coping strategies in dealing with computer problems. The coping strategies employed by high-computer stress users were primarily emotional-focused coping strategies. The low-computer stress group tended to adopt a problem-solving coping strategy in dealing with computer problems.

EFFECTS OF INTRAOLIVARY HARMALINE INJECTIONS ON
OLIVOCEREBELLAR TRANSMISSION IN THE NORMAL AND DYSTONIC RAT
Jason M. Smith & Joan F. Lorden, Dept. of Psychology, UAB, Birmingham, AL 35294.

The genetically dystonic rat displays a generalized movement disorder characterized by twisting movements of the trunk and limbs. The dt rat is insensitive to the effects of harmaline which causes tremor in normal rats. Harmaline activates the olivocerebellar pathway by facilitating neurons in the caudal medial accessory olive (cMAO), which serves as a pacemaker for the tremor, and this activity is transmitted by climbing fibers to Purkinje cells in the cerebellar cortex. Purkinje cells show two responses to harmaline. Simple spikes (SS) are suppressed and complex spikes (CS) increase in firing frequency and rhythmicity. Extracellular single unit recording was used to evaluate Purkinje cell responses to harmaline applied directly to the cMAO by microinjection to determine if facilitation of the cMAO alone is sufficient to cause SS suppression and increased CS rates and rhythmicity, and to compare normal and dt rat responses to intraolivary injections of harmaline. After microinjections of harmaline to the cMAO, Purkinje cell responses in normal rats showed the predicted effects. Purkinje cell responses in the dt rats failed to show any change from baseline recordings in over 85% of the postdrug samples. Microinjection data were compared with IP injection data and showed no difference when injections were to the cMAO. Microinjections outside the cMAO showed no difference from baseline samples. This indicates that the cMAO is responsible for the neural activity correlating with tremor during harmaline intoxication and that facilitation of the cMAO is not dependent on harmaline activation of olivary afferents. Purkinje cells in the dt rat fail to respond to afferent input from the cMAO and failure of transmission may be dependent on defects within the olivocerebellar pathway.

INVESTIGATION FOR THE STORYTELLER. Brenda J. Lewis
Dept. of Criminal Justice and Criminology, Alabama
State University, Montgomery, Al 36101

One of the biggest problem in presenting information to juries at trial is the use of complicated language and scientific explanations. The investigator is the key person to developing the client's story in criminal cases. Lawyers expect a "magic bullet" that will tell them that the clients did not commit the crime. They usually believe in their hearts that the client is guilty^D and if he's not there is a reasonable explanation that will show he's not guilty. This is where the investigator helps the attorney with building facts for defense to tell their story.

Abstracts

MARIJUANA: ISSUES AND PERSPECTIVES FOR MEDICAL LEGALIZED USAGE. Nicholas Astone, Department of Criminology and Criminal Justice, Alabama State University, Montgomery, Alabama 36101.

The author presents historical data on medical uses of marijuana. Contrary to public opinion, clinical use of marijuana is perceived as safe and effective as an aid to alleviate the nausea associated with chemotherapy, as an anticonvulsant in spastic disorders, lowering intraocular pressure in glaucoma, chronic pain, phantom limb pain, menstrual cramps and as an appetite stimulant in the wasting syndrome of human immuno-deficiency virus infection. Finally, preliminary research indicates that marijuana has little effect on major physiological functions; there is no known case of a lethal overdose and it is far less addictive and subject to abuse than muscle relaxants, hypnotics, and analgesics.

PSYCHOLOGICAL ASSESSMENT OF BLIND VETERANS IN REHABILITATION: A STUDY USING THE HOPE SCALE. Andrew D. Palmatier¹, Warren T. Jackson¹, Robert E. Taylor², & Timothy R. Elliott¹, ¹Department of Rehabilitation Medicine, University of Alabama at Birmingham, Birmingham, AL 35233, and ²Southeastern Blind Rehabilitation Center, Veterans Affairs Medical Center, Birmingham, AL 35233.

Hope among older persons with blindness and how it varies with cause (e.g., glaucoma) and severity (e.g., decreased acuity) of vision loss may be important in determining rehabilitation outcome and psychosocial functioning. Such a relation has received little attention due to the difficulty of administering self-report measures to persons with blindness. In the current study, 63 adventitiously blinded Veterans were given an oral administration of the Hope Scale at the onset of their rehabilitation. The Hope Scale consists of 12 questions: four questions measure one's determination in accomplishing personal goals (agency), another four questions index perceived availability of successful means to obtain goals (pathways), and the final four questions are distractors. Subjects were instructed to give oral responses to the questions using the four-point Likert-type scale that ranged from 1, "Definitely False" to 4, "Definitely True." Results of separate one-way ANOVAs revealed no differences between the means of the Hope Scale "agency" and "pathways" scores across cause and severity of vision loss. Furthermore, previous work and current findings suggest the administration of the Hope Scale can be altered to accommodate a verbal question and answer format. Future research will attempt to extend present findings by exploring the effect of hope on coping and adjustment to vision loss.

Abstracts

THE POLITICS OF CRIME PREVENTION AND CONTROL. Jerald C. Burns, Department of Criminology and Criminal Justice, Alabama State University, Montgomery, Alabama 36101.

The purpose of this paper is to explore the implications of the 1994 Crime Bill and the perceived attempts in 1995 by the Republican congress to politicize the whole issue of crime prevention and control. The discussion focuses on what programs are really needed to prevent crime versus those that have been funded or proposed by congress. One conclusion that is drawn is that much of the legislation approved or proposed may have costly, negative and damaging consequences for the future of the criminal justice system and may not prevent or control crime.

SCIENTIST AS HERO IN MARCEL PROUST'S IN SEARCH OF LOST TIME.
William C. Carter, Dept. of Foreign Languages, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

For French novelist Marcel Proust, whose masterpiece In Search of Lost Time many consider to be the greatest novel of the twentieth century, the role of the artist and scientist in society is the same. The only difference between the way in which scientists and artists create is procedural rather than substantive: "The impression is for the writer what experiment is for the scientist, with the difference that in the scientist the work of the intelligence precedes the experiment and in the writer it comes after the impression." As far as vision and imagination are concerned, Proust does not distinguish between artists and scientists: their common duty is to decode, to make clear what was obscure. "To make visible" is the watchword of the Proustian artist, a watchword he extends to his fellow scientific explorers. Vinteuil, Proust's fictional composer, is compared to Ampère, Lavoisier, and other pioneers in art and science whose mission is to reveal the laws that govern the universe. The truths derived from these laws are as precise in art as in science: "Truth, even literary truth, is not the fruit of chance. . . . I think truth, (literary truth), reveals itself whenever it does, like a physical law. One discovers it or one doesn't." Proust's hero is the creative person, artists and scientists, all of whom are tireless seekers of the truth.

Abstracts

HEALTH SCIENCES

PARENTING AND CHILDREARING ATTITUDES AMONG HIGH SCHOOL STUDENTS: EFFECTS OF A CHILD ABUSE PREVENTION UNIT IN THREE SCHOOLS. Ellen Buckner, Elaine Marshall and David Helms, University of Alabama at Birmingham, Alabama 35294.

The purpose of this study was to assess changes in parenting attitudes as an effect of a child abuse prevention unit taught in a required health class. Based on a preliminary study indicating a slight beneficial effect, this study was an extension to a more diverse student population. Data were obtained from three schools including 2 general metropolitan public high schools and a high school from a suburban independent school system (N=423). Students completed the Bavoleck Adult Adolescent Parenting Inventory before and after the week long class on child abuse prevention concepts. Results indicated a positive or beneficial increase in parenting attitude scores in some or all constructs in all three schools ($p < .05$). Low scoring students at pretest also evidenced statistically significant gains compared to controls. Recommendations for curriculum development are made based on these findings.

Lived Experiences of Women in Treatment for Weight-Loss: A Feminist Analysis (Kay M. Lopez). Dept. Of Nursing, University of Alabama At Birmingham, Al., 35294-1210

Because of their concern with body size, women are the primary users of weight treatment programs. Since weight treatment programs have poor long term outcomes, many women return for treatment time after time. This phenomenologic study, guided by feminist theory, explored women's experiences with weight treatment, as well as the personal meanings they attached to these experiences. Subjects were recruited from three types of weight treatment programs and were interviewed using Seidman's method. The theme of value conflict was evident in the subject narratives. These women had difficulty balancing the requirements of their programs with their perceived obligations as spouses, parents, and breadwinners. Subjects who were not severely obese were motivated by appearance concerns, rather than health, to enter treatment. One study conclusion was that ambiguity between health and attractiveness as reasons for seeking weight-loss, perpetuates the value conflict of women in treatment. A study implication was that nurses counseling women who seek weight-loss should promote values clarification of clients so that they can make more informed decisions regarding weight management within the context of their personal lifestyle priorities.

Abstracts

THE RELATIONSHIP OF SELECTED DEMOGRAPHIC CHARACTERISTICS, HEALTH CONDITIONS, AND PERSONALITY HARDINESS WITH QUALITY OF LIFE IN OLDER ADULTS. Barbara F. Wilder, School of Nursing, Univ. of AL in B'ham, Birmingham, AL.

The purpose of this study was to explore the relationship between selected demographic characteristics, preexisting health conditions, personality hardiness, and quality of life among older adults. The conceptual framework used to guide this study was derived from the General Systems Theory. A survey approach with a correlational design was used in this study. The convenience sample included 96 older adults between the ages of 65 and 94 years.

Personality hardiness was measured by the Personal Views Survey (PVS). Quality of life was examined by the Life Satisfaction Index-Z (LSI-Z) measuring overall life satisfaction, and the Medical Outcomes Study (MOS) Short Form Health Survey (SF-36), measuring functional health status. Demographic characteristics and preexisting health information were collected using an investigator-developed questionnaire.

Descriptive statistics were used to describe the sample. A selection of bivariate and multivariate statistics was used to evaluate the research questions. The findings showed that greater hardiness was related to increased functional health status and greater life satisfaction. A canonical correlation between the set of descriptive characteristics (age, income, and education), preexisting health conditions, personality hardiness, and the set of quality of life components (functional health status and life satisfaction) revealed that 77% of the variance in functional health status and life satisfaction was explained by the combination of demographic variables. The study findings provided partial support for the conceptual model and the previous research literature.

INFLUENCES OF CORONARY ARTERY DISEASE KNOWLEDGE, ANXIETY, SOCIAL SUPPORT, AND SELF-EFFICACY ON THE ADAPTIVE HEALTH BEHAVIORS OF PATIENTS TREATED WITH A PTCA. Barbara B. Rees, School of Nursing, University of Alabama at Birmingham, Birmingham AL 35294-1210.
Barbara B. Rees, Floyd College, P.O. Box 1864; Rome, GA 30162-1864.

The purpose of this study was to determine the relationship among coronary artery disease knowledge, anxiety, social support, and self-efficacy and the adaptive health behaviors of diet, exercise, and smoking. The Roy Adaptation Model served as the conceptual framework. A convenience sample of 82 first-time PTCA patients were interviewed in the hospital and 6-8 weeks post discharge. Instruments included the Coronary Angioplasty Risk Factor Inventory, the State-Trait Anxiety Inventory, the Perceived Support Inventory, and the Cardiac Diet, Exercise, and Smoking Self-Efficacy Instruments. Multiple regression showed that self-efficacy was the single most predictive variable for adaptive behavior (diet: $R^2 = .24$, $p = .00005$; exercise: $R^2 = .20$, $p = .0001$; smoking: $R^2 = .54$, $p = .0002$). Canonical correlation suggested subjects with higher self-efficacy and less anxiety improved their exercise and smoking behavior ($p = .0001$). Implications include nursing care focused on lowering patients' anxiety while increasing self-efficacy.

Abstracts

THE MEANING AND SIGNIFICANCE OF HOMELESSNESS TO A CHILD: A PHENOMENOLOGICAL INQUIRY. Linda Sullivan, Mississippi University for Women, P.O. Box W910, Columbus, MS 39701.

Homelessness is not a new phenomenon but recent media attention has increased society's awareness of its magnitude. Today, the fastest growing segment of this population is families with children (ca. 600,000). Since so little is known about homeless children, this study investigated the meaning and significance of homelessness to a child. The phenomenological method was employed and the sample included nine homeless children aged 7 to 11 residing in shelters in either Mississippi or Georgia. Analysis of the data was accomplished using van Kaam's methodology. Three clusters along with nine themes were uncovered. All the children related violent and/or disruptive events prior to coming to the shelter. Few had any friends or extended families and all felt safer and more secure in the shelter. None of the children perceived themselves as homeless and all the children felt that the shelter was their home. Their hopes and dreams centered on meeting the most basic needs: food, shelter, money and safety. Homelessness meant a disruption in the normal life pattern which caused deficits in basic needs. Violence and isolation was accompanied by, and often the cause of, the breakdown of families, an increased incidence of chronic illnesses, poor school performance and the lack of a significant support group. Homelessness therefore was not defined as a lack of a home but rather a lack of structure, filled with deficits and disruptions that diminished a child's life. The results identified the multiple stressors faced by the children and provided important information that may assist the health care provider in rendering appropriate and timely care for the homeless child.

OBSTACLES TO DELIVERY OF QUALITY CARE IN THE MANAGED CARE ERA.

Robert E. Pieroni, Dept. of Internal Medicine and Family Medicine, Univ. of Ala., Tuscaloosa, AL 35487-0326.

The Health Maintenance Organization (HMO), the prototype of Managed Care Organizations (MCO's), was initiated by Sidney Garfield, M.D., and nurtured by the entrepreneur Henry J. Kaiser. The Kaiser Permanente Plan, despite considerable opposition from organized medicine, had a laudable effect on the health of thousands of families, and was the driving force behind the numerous MCO's that have sprung up throughout the U.S. Unfortunately, many of Garfield's idealistic conceptions have all too often been subverted by financial and other constraints (e.g. managed care vs. managed costs). I shall describe the numerous concerns about the operations of some current MCO's and their potential to impact negatively upon the provision of appropriate medical care. Suggestions to minimize possible abusive practices will be addressed.

Abstracts

ROLE OF H. PYLORI IN GASTRIC LYMPHOMA. Robert E. Pieroni and Jerrold S. Canakis, Univ. of Ala., Dept. of Internal Medicine, Tuscaloosa, AL 35487-0326.

In the 1930's cancer of the stomach was the most frequent carcinoma in adult Americans. After a dramatic decline, cases of cancer have plateaued during the past decade and post-treatment survival rates have remained discouraging. In 1982 when Helicobacter pylori was successfully cultured, and subsequently has been shown to be associated with the majority of cases of peptic ulcer disease and certain stomach cancers. An extremely high association between infection with H. pylori and a recently identified stomach malignancy, "mucosa-associated lymphoid tissue (MALT) lymphoma," has been recognized. Short term therapy with antimicrobials and proton-pump inhibitors has resulted in complete tumor regression in the majority of these patients. We shall present a case of a female with MALTOMA and discuss her therapy, and other manifestations of this interesting disorder.

RELATIONSHIP OF TRAUMATIC BRAIN INJURY TO ALCOHOL USE. Toni Jordan, Kay Canupp, and Thomas Novack, Spain Rehabilitation Center University of Alabama at Birmingham, Birmingham, Alabama 35294

A prospective study was performed to determine the relationship between traumatic brain injury and drug and/or alcohol use. One hundred fourteen patients with traumatic brain injury were entered into the study. Criteria for admission to the study was based on a stay in the neurointensive care unit at a university hospital of at least 48 hours. In addition, study cases were identified by loss of consciousness, post-traumatic amnesia, skull fracture, and/or objective neurological findings. Subject meeting criteria were assessed for etiology of head injury, seat belt use, drug and alcohol screen and Glasgow Coma Scale Rating. One third (41/114) subjects with head trauma had a positive screen for drugs or alcohol. In those subjects who experienced a motor vehicle accident (MVA) (n=67), eighty-nine percent were not wearing seat belts. The evidence continues to show the risk factors of association between drug/alcohol use and seat belt non-use in the etiology of brain injury.

Abstracts

IMMUNOHISTOCHEMICAL DETECTION OF TOXOPLASMA GONDII: A NEW MONOCLONAL ANTIBODY. B. H. Estridge and C. A. Sundermann, Dept. Zoology & Wildlife Sci., Auburn Univ., AL. M. Branton, Dept. Biology, Stillman College, Tuscaloosa, AL. D. S. Lindsay, Dept. Pathobiology, Auburn Univ., AL.

A commercial anti-*Toxoplasma gondii* antiserum was compared with new monoclonal antibody (MAB) 3F5 for specificity and ease of use in identifying *T. gondii* in formalin-fixed paraffin-embedded tissues. Human tissue naturally infected with *T. gondii* and animal tissues experimentally infected with *T. gondii* or related apicomplexans were immunostained with MAB 3F5 or the commercial antiserum using an avidin-biotin horseradish peroxidase system (VECTASTAIN® ABC). MAB 3F5 labeled intracellular tachyzoites and margins of parasitophorous vacuoles of the RH strain and portions of tissue cysts of the ME-49 strain. No cross-reactivity was observed in tissues containing developmental stages of *Caryospora bigenetica*, *Hammondia hammondi*, *Sarcocystis cruzi* or *Neospora caninum*. Trypsin pretreatment of tissue neither enhanced nor diminished staining by MAB 3F5. The commercial antiserum stained *T. gondii* stages but cross reacted with *N. caninum*, required pretreatment of tissue with enzymes (manufacturer's instructions), and often gave high non-specific (background) staining. Immunoblot analysis of preparations of RH strain tachyzoites revealed that MAB 3F5 reacted with 38 kD (major) and 82 kD (minor) bands. Ultrastructural analysis of RH strain tachyzoites following immunogold application showed gold decoration of dense granules. MAB 3F5 should be a valuable tool for identifying *T. gondii* in histological specimens because of the advantages of its apparent lack of cross-reactivity with related apicomplexans and its reactivity in the absence of enzyme pretreatment of tissue sections. Supported by Howard Hughes Institute Future Life Science Scholars Program and Alabama Agricultural Experiment Station, Auburn Univ.

SWINGING FROM TRADITIONAL MEDICAL DRUG TREATMENT TO ADVENTURE BASED COUNSELING FOR ADOLESCENT POPULATIONS. Sunny Wood, University of Alabama School of Nursing, University of Alabama at Birmingham, Birmingham, AL 35294-1210

Traditional programs which emphasize drug and alcohol abuser's admission of powerlessness may fail with the adolescent population. Wilderness or adventure based programs such as C.O.P.E. (Challenging Outdoor Personal Experiences) offer adolescents the opportunity to explore new ways to deal with, react to or control their environment.

Adventure based experiences build group identity through contracts in which members agree not to devalue or discount themselves or other group members. This contract shows them that their actions and those of others directly affect the group. Group goals of C.O.P.E. include development of 1) leadership; 2) problem-solving; 3) communication; 4) self-esteem; 5) trust; 6) decision-making; and 7) team work. Counseling may supplement the adventure based experience. C.O.P.E. experiences may include low and high ropes courses and a team approach to achievement. The self-empowering approach can be beneficial for some adolescents struggling with drug or alcohol problems.

TRANSEPITHELIAL TRANSPORT OF A BORONATED DI-PEPTIDE ACROSS A CELL MODEL: HCT-8.

J. G. Eley, Samford University, School of Pharmacy, Alabama, I. Hall, M. C. Miller III, and A. L. Elkins, University of North Carolina at Chapel Hill, School of Pharmacy.

During enzymatic hydrolysis peptide drugs lose the efficacy attributed to the original molecule. By the substitution of a boron atom in place of an amino α -carbon atom it was thought that a delay in enzymatic hydrolysis might be achieved.(1) Transport studies across monolayers of HCT-8 cells were conducted using a boronated glycine phenylalanine (Gly-Phe) derivative, Trimethylamine carboxyborane-phenylalanine methyl ester (compd. I) and a control (compd. II). Cells were grown on polycarbonate, microporous membranes in Transwell® systems. Cell confluence and formation of tight junctions were tested before and after experiments with transepithelial electrical resistance (TEER). After four hours exposure, analysis was conducted by HPLC, where two peaks were observed thought to be caused by ester hydrolysis and having characteristics of trimethylamine carboxyborane-phenylalanine (FA) in major proportions, eluting after the Phe-OMe ester. Comp. II degraded faster than Compd. I with longer retention time and no clear peaks. Of the two concentrations used (0.75mM and 1.5mM) Compd. I in the higher concentration was taken up more rapidly from apical to basal domains. In conclusion, the boronated dipeptide was more extensively transported and showed greater stability than control. Transport across the HCT-8 monolayer was by passive diffusion and was proportioned to the initial concentration.

(1) A. Elkins, MSc. Thesis. UNC.CH.(1993).

COMMUNITY HEALTH NURSING IN BRAZIL: A STUDENT EXPERIENCE FOR THE WHO INTERNATIONAL CENTER FOR NURSING. Julie Diniz, University of Alabama School of Nursing, University of Alabama at Birmingham, Birmingham, AL 35294-1210

This student experience was conducted at the public health clinic of Rio Largo, Alagoas, Brazil, June 19-30, 1995. The clinic sees patients of all ages. More than half of the clients are women and children. This clinic is important not only in medical services provided but also because it provides needed education on hygiene, birth control, nutrition, and breast feeding. It runs massive vaccination campaigns for children against common infestations.

Patient load was high and a frequent problem was malnutrition in children. Nurses, doctors and social workers worked to educate mothers on the child's needs. Future initiatives must include curative medicine and public education.

Abstracts

Well-being of Families Who Care for Healthy and Technology Assisted Infants Charlotte Stephenson, RN, DSN, Mississippi College

Family well-being is an indicator of family adaptation. This study explored the relationship between pile-up of demands, coping and well-being of families with healthy and technology assisted infants. Using the Double ABCX Model of Family Adjustment and Adaptation, the research tested four hypotheses. The sample included 172 families in two groups. The technology group ($n=85$) included infants: a) requiring selected technology, b) requiring intensive care, c) at home more than two weeks. The healthy group included infants: a) not requiring technology, b) not requiring intensive care, c) at home more than two weeks. Families completed a demographic form, and standardized questionnaires: Family Inventory of Life Events, Family Crisis Oriented Personal Evaluation Scale, and Family Well-being Assessment. The research found that increased pile-up of demands were related to decreased family well-being. Higher levels of coping were related to higher family well-being. However coping and pile-up of demands were not related. The technology group had more pile-up of demands and lowered well-being than the healthy group. However, the levels of family coping were not significantly different. Conclusions: a) vulnerable families had increased pile-up of demands, and lowered well-being, b) the technology group was more vulnerable than the healthy group, c) parents with new infants, whether technology assisted or healthy, had higher levels of family coping. Implications: a) using the Double ABCX model to identify families at risk, b) using results in anticipatory guidance c) acknowledging that parenting a new infant elicits higher levels of family coping. Recommended research: a) follow-up to ascertain changes b) using families with multiple infants, c) study other family concepts

SCROFULA IN AIDS PATIENTS. April Butsch, Helvi McCall, and Robert E. Pieroni, Univ. of Ala. School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487-0326.

Tuberculous cervical lymphadenopathy is an uncommon manifestation of TB. Before widespread pasteurization of milk and tuberculous control in cattle, many cases resulted from Mycobacterium bovis. Although atypical mycobacteria has been associated with cervical lymphadenopathy, M. tuberculosis is mainly responsible for cases detected in the U.S. With the emergence of AIDS, cases of tuberculosis, including scrofulous manifestations, have risen significantly. We shall present several cases of scrofula and discuss the fascinating history of this disorder (termed the "King's Evil" during the Middle Ages), and various therapeutic approaches ranging from the "royal touch" to modern surgical and chemotherapeutic approaches. The importance of early recognition of scrofula, and the possibility of positive HIV status, will be emphasized.

Abstracts

CANCER: POTENTIAL USE OF ONCOFETAL ANTIGEN IN DETECTION, PREVENTION, AND TREATMENT. Shirley D. Rohrer, Dept. of Natural Science, University of Mobile, Mobile, AL 36663. James Rohrer, Adel Barsoum, and Joseph Coggin, Jr., Dept. of Microbiology, Univ. of S. Alabama, Mobile, AL 36688.

Oncofetal antigen is a conserved, tumor and fetal tissue-restricted, cell surface-associated glycoprotein. OFA is present on rodent fetal cells during some phases of normal gestational development--and on virtually all tumor cell lines and freshly excised tumor specimens. Monoclonal antibodies were used as a tool for the visualization of the 44-kDa OFA. Sarcomas, lymphomas, and carcinomas generated by chemical, radiation, or viral exposure in mice, hamsters, and humans possessed the oncofetal antigen marker on their cell surfaces. Using the mouse as an animal model system, tumor and mid-gestation fetal cells--but not newborn or adult cells expressed OFA. Similar results were obtained with human tumor and adult cells. In a murine radiation-induced thymic lymphoma, the cell-surface presence of OFA was demonstrated to be a premalignancy marker for the onset of cancer. The detection of oncofetal antigen preceeded the presence of histological evidence of the tumor. These lymphoma cells are immature thymus cells capable of producing the cytokine gamma interferon. Unlike many other clinical tests for cancer, OFA in adults is found only on tumor cells. There is potential for the development of cancer test kits--for the detection of OFA in the serum or of the body's immune response directed against it (serum antibodies capable of binding to OFA). Blood levels of OFA and/or anti-OFA could also be used as an indicator of the continuing success of a cancer treatment protocol. Tumor cells could be directly targeted for death by using toxic molecules coupled to monoclonal antibodies. Finally, OFA could be used as a vaccine against cancer.

Biochemical markers for prenatal screening. Larry R. Boots and D.C. Chu, Department of OB/GYN, University of Alabama at Birmingham, Birmingham, 35294.

Maternal serum samples from normal and Down syndrome-affected pregnancies from 14 to 20 weeks of gestation were analyzed retrospectively for seven maternal serum markers including alpha-fetoprotein (AFP), human chorionic gonadotropin (hCG), human placental lactogen (hPL), pregnancy-specific B₂-glycoprotein (SP-1), unconjugated estriol (uE3), and insulin-like growth factor binding protein-3 (IGFBP-3) to identify or predict pregnancy outcomes. Weekly means, standard deviations, and medians were determined for each marker. Correlation analysis was performed to determine if significant differences in these marker levels between normal and Down syndrome-affected cases existed. Maternal factors including age, weight, race, and week of gestation were similarly analyzed. Regression analysis using stepwise procedures was performed to identify which variable combinations allowed significant discrimination between normal and Down syndrome-affected pregnancies. The results showed that the detection rates for Down syndrome-affected pregnancies were 89% (using AFP, hCG, IGFBP-3, and maternal age) or 80% (using AFP, hCG, SP-1, uE3, and maternal age).

THE EFFECTIVENESS OF THE WRITTEN NURSING CARE PLAN AS A MEASURE OF CRITICAL THINKING. Pat Goodman, RN, Ph.D., Martha G. Lavender, RN, DSN and Portia Foster, RN, DSN, Jacksonville State University, Jacksonville, AL 36265

Evidence of defining, measuring, and utilization of curricular outcome data in maintaining and/or revising nursing programs is a required component of the accreditation process. Many educators agree that implementing strategies to promote and measure critical thinking constitute valid issues of concern in the profession. The nursing process, viewed as an adaptation of the scientific method, is now being questioned as a reliable measure of critical thinking in light of today's transforming health care environment. The purpose of this study was to determine if nursing care plans (utilizing nursing process) were an effective measure of the progressive development of critical thinking in baccalaureate nursing students. The comparative-descriptive design employed paired nursing care plans. The convenience sample (n=40) was given a scenario to provide information for construction of a nursing care plan. The first care plan was submitted in the beginning of the second semester of the junior year. The second care plan was developed using the same scenario at the beginning of the first semester of the senior year. Critical thinking was measured using the numerical scores from the paired nursing care plans to measure progression of critical thinking. The results of the paired t-test analysis supported retaining the null hypothesis. Additional analysis was conducted to establish reliability for the raters. Inter-rater reliability was significant at $p = 0.001$ supporting consistency between the raters. Further research is needed to identify reliable formative and summative evaluation tools for critical thinking.

ROOMING-IN, ATTITUDES OF NURSES TOWARD. Lydia D. Andrews, University of Alabama at Birmingham, Birmingham, AL 35294-1250.

In many institutions, the practice of family-centered maternity care includes rooming-in as an option. This descriptive study was designed to describe the attitudes of nursery nurses toward rooming-in. Data were obtained through the use of an investigator-constructed demographic questionnaire and a Likert-type attitude scale. A convenience sample of 29 registered nurses and 14 licensed practical nurses participated in the study. Orem's self-care theory and Lewin's change theory provided the theoretical framework for this study. Results indicated that nurses have positive attitudes toward rooming-in. It was recommended that:

1. The sample size be increased to include obstetricians, pediatricians, family practice physicians, nurses in all three obstetric areas, neonatologists, medical students, hospital administrators, and expectant mothers.
2. The instrument be modified to include additional items for fathers and a group of open-ended questions.
3. The study be replicated to control for type of nursing education, length of experience in obstetric nursing, age of the nurse, and the nurse's own rooming-in experience.

Abstracts

SPIRITUALITY: THE HIDDEN SIDE OF HEALTH.

Theresa A. Wynn, Dept. of Human Studies,
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Can a person function in today's society without a brain? Or, is it possible for an individual to perform behavioral tasks without the aide of a physical body? The answers to these questions are absolutely NO! Then why do we as health professionals expect individuals to function properly without the assistance of a soul or spirit? The health care field has successfully been able to explore the human body at the cellular level and beyond with the aide of sophisticated instruments and procedures. Health professionals have discovered cures, formulated diagnoses, and implemented health programs at the micro and macro level. Certainly it would be safe to say that progress has been made. However, along the way to health and educational stardom, we as health professionals and educators have lost sight of a vital component of health. The hidden side of health which is least mentioned in the medical and educational setting is the concept of spiritual health. Acknowledgements: I thank my Lord and Savior JESUS CHRIST for giving me the inspiration to write this paper, my parents Mr. and Mrs. Arthur Wynn Sr., and my pastor Bishop Heron Johnson. Thank you for your encouragement and support.

PITFALLS IN THE DIAGNOSIS OF DIABETIC KETOACIDOSIS. Robert E.

Pieroni, Dept. of Internal Medicine and Family Medicine, Univ. of Ala, Tuscaloosa, AL 35487-0326.

Before the discovery of insulin in 1922, diabetic ketoacidosis (DKA) was uniformly fatal. DKA, which can also occasionally develop in noninsulin-dependent diabetics, has several diagnostic criteria including elevated glucose (greater than 250mg/dl), low pH (less than 7.35), low bicarbonate, high anion gap and positive serum ketones. This presentation will emphasize exceptions to the above criteria, e.g., medical conditions leading to alkalemic DKA, euglycemic DKA, and nonketonemic DKA. Failure to recognize these potential pitfalls to the diagnosis of DKA could lead to disastrous consequences. The pathogenesis, diagnosis and appropriate management of the various forms of DKA will be described.

Abstracts

Comparison of Special Care Unit and Traditional Care Unit Residents Experiencing Dementia in a Nursing Home: A Naturalistic Study.
Evelyn L. Fitzwater, School of Nursing, UAB, Birmingham, Al.

Special care units (SCUs) for residents experiencing dementia have increased rapidly in United States nursing homes since 1983. Minimal consensus exists in the literature as to what a special care unit is and whether it differs from the more traditional nursing home units (TCUs) providing care for residents experiencing a wide variety of care needs. Few scientific studies exist which support the SCU model as different in comparison to traditional care. The purpose of this study was to determine whether differences existed between these two care models as observed in 27 variables including staff/resident verbal and/or tactile interaction environmental/contextual factors, and behavioral outcomes. The sample consisted of 14 SCU and 14 TCU residents randomly selected from an equivalent group in the same nursing home matched on cognition level, ADL status, and disruptive behavior symptoms. Three hours of observation data were recorded on all subjects using a hand-held microcomputer and a specially designed direct observation program for naturalistic data collection. Nonobservation data comparison included psychotropic medication regime and family/staff satisfaction levels. Randomization tests for significance indicated that SCU residents engaged in verbal interaction 2.5 times more often; engaged 3 times more often in touch behaviors; engaged in formal group activities 3 times more often than TCU residents who were observed 3 times more often spending time alone. SCU residents received significantly more psychotropic medications. Non-significant differences were found between groups in staff reported job satisfaction and family satisfaction with care. The computer assisted, real-time data collection system is an effective method for use in a variety of investigations, including out-come evaluation research. Future research combining qualitative-quantitative studies are needed to discover quality care indicators.

PERIPARTUM CARDIOMYOPATHY: CASE REPORT AND LITERATURE REVIEW.
Brad Jacobs, Sarah Bisch, Cathy Gresham, and Robert Pieroni, Univ. of Ala. School of Medicine, Tuscaloosa Program, Tuscaloosa, AL 35487-0326.

Peripartum cardiomyopathy (PPCM) is an important, albeit over-diagnosed, cause of pregnancy-associated heart failure. It has been defined as a dilated cardiomyopathy which occurs during the last month of pregnancy or within five months of delivery in the absence of another identifiable etiology, or other cardiac disease. The incidence of PPCM has been estimated to be one in 30,000 deliveries. We shall present manifestations of a patient with post-partum cardiac failure and, discuss the differential diagnoses, clinical manifestations and treatment modalities of such patients, as well as current knowledge concerning pathogenesis of PPCM.

ENTEROCOCCAL INFECTIONS: THERAPEUTIC IMPLICATIONS OF ANTIMICROBIAL RESISTANCE. Tracy L. Johns and Robert Pieroni, The University of Alabama School of Medicine, Tuscaloosa, Alabama 35487-0326.

Enterococci have recently emerged as prominent nosocomial pathogens. They are intrinsically resistant to several antimicrobials and acquired resistance mechanisms have been described. Plasmid-mediated beta-lactamase production and high-level aminoglycoside resistance have limited the usefulness of this otherwise synergistic combination. Also, vancomycin-resistant enterococci (VRE) have been identified. In fact, data reported to the National Nosocomial Infections Surveillance System indicate the percentage of nosocomial VRE increased from 0.3% in 1989 to 7.9% in 1993. Vancomycin inhibits cell wall synthesis by complexing with D-alanine-D-alanine termini of peptidoglycan precursors. This weakens the cell wall resulting in bacterial lysis. The VanA resistance phenotype is inducible, transferable and associated with glycopeptide resistance as a class. This phenotype is characterized by expression of three proteins necessary for vancomycin resistance. The VanH protein converts pyruvate to D-lactate. VanA ligates D-alanine and D-lactate to form a peptidoglycan precursor with reduced affinity for vancomycin. VanX then destroys all normal D-alanine-D-alanine so that organisms are required to use the altered precursor for cell wall synthesis. High-level resistance to glycopeptides often accompanies acquired resistance to beta-lactams and aminoglycosides; therapeutic options in this setting are limited. Vancomycin use is a risk factor for colonization and infection with VRE. Prudent use of vancomycin along with other measures to halt the spread of VRE can significantly reduce the threat of these potentially untreatable pathogens.

ENGINEERING AND COMPUTER SCIENCE

DISJOINT PATHS ALGORITHMS ON COGRAPHS. Hiryong Kim and Alan Sprague, Dept. of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

This paper treats two path problems. We present an $O(n)$ algorithm to find a maximum set of vertex disjoint paths joining two given vertices s and t in a cograph on n vertices. Also, given a cograph G , integer k , and $2k$ terminals $s_1, s_2, \dots, s_k, t_1, t_2, \dots, t_k$, we present an $O(\max(nk, \beta(n,k)))$ algorithm for a maximum set of vertex disjoint paths, each path joining a terminal s_i to the corresponding t_i . Here $O(\beta(n,k))$ is the time complexity of matching on a bipartite graph having n and k vertices on the two sides of the bipartition. We presume that the given cograph is represented by its cotree.

Tiny C++ Compiler - a Formal Semantics based Implementation. Prakash K. Muthukrishnan, Dept. of Computer and Information Sciences, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

This research was an effort to formalize the semantics of object-oriented languages. An object-oriented language has linguistic support for *objects*, *message passing*, and *inheritance*. In order to develop the semantics, we defined a language called TinyC++ which is a distilled version of C++. TinyC++ has the linguistic support for the above mentioned object-oriented features, arithmetic expressions and commands. The result of this research is a definition of the semantics using continuation denotational semantics and also an implementation of a compiler for TinyC++ based on the semantics. We have extended TinyC++ to include *polymorphism* via dynamic binding and currently defining the semantics of the same. This research has been supported, in part, by the Alabama Academy of Science grant. My sincere thanks to Dr. Barrett R. Bryant for his help in my research efforts.

BARRIER HEIGHT MODIFICATION FOR METAL CONTACTS ON WIDE BANDGAP SEMICONDUCTORS. C. van Eyck, S. Reynolds, and K. Das, Department of Electrical Engineering, Tuskegee University, Tuskegee, AL 36088.

Prior research had demonstrated for the case of Si Schottky diodes that the barrier height can be adjusted by the introduction of a shallow implant of dopants prior to metallization. A dopant implant of conductivity type opposite to that of the substrate increased the barrier height, whereas an implant of the same type effectively reduced the barrier. In this report, it is demonstrated that an adjustment of the barrier height of rectifying Au contacts on β SiC (n-type) and naturally occurring p-type semiconducting diamond (type IIb) can also be achieved by employing a premetallization low-dose ion-implantation step. In the case of SiC, low doses of either Al or N was employed in order to achieve p and n-type activity, respectively. The implanted samples were annealed at a temperature of 1200 °C in an oxidizing ambient. Subsequently the oxide film was removed using a buffered oxide etch prior to metallization employing an e-beam evaporated Au film. Observed current-voltage characteristics of subsequently metallized samples qualitatively related to an increased barrier height for a low dose Al implant (p-type) and to a lowering of barrier height with a N implantation (n-type) step. Although Au is not considered to be compatible to high temperature operation of SiC devices, with a suitable metallization the possibility of barrier modification provides a degree of flexibility in design and fabrication of high-temperature SiC rectifiers and MESFETs. For contacts on semiconducting diamond, in the absence of a suitable substitutional donor, donor activity of residual implantation-induced damage was utilized for obtaining n-type conduction. Low-dose implantation of B with a subsequent thermal anneal was employed for introducing stabilized n-type conduction in the sub-surface region of the IIb crystal. With a higher dose of B the donor activity was compensated and acceptor activity arising from substitutional B dominated. Observed current-voltage characteristics of subsequently metallized samples qualitatively related to an increased barrier height for a low dose B implant and to a lowering of barrier height with an increased dose of implanted B.

HETEROGENEOUS PROCESS MIGRATION AND REGISTER CARDINALITY.

Mallikharjun Yalamanchili, Dept. of Computer and Information Sciences, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

Process migration is the most logical way to dynamically balance the processing load on the various hosts in a distributed computing environment and is a very complicated task to accomplish. It becomes even more cumbersome in heterogeneous distributed systems, primarily due to the heterogeneity in machine architectures. Once such principal variation which is immediately reflected on the process state and executable code being migrated is the differences in the number of registers on various machines. A process migration mechanism being developed at UAB that deals with the heterogeneity in register cardinality for hypothetical architectures will be discussed.

Articulatory Based Phoneme Recognition System Using Artificial Neural Networks.

Sharlene D. Newman, Martin M. McCutcheon, Ph.D., Dept. of Biomedical Engineering, Univ. of Ala., at Birmingham, Birmingham, AL 35294

In the study of speech recognition emphasis has been placed on acoustic based systems. Although acoustic based recognition systems have a broad range of possible applications there are instances in which an articulatory based (based on vocal tract configuration) recognition system would be desirable. One instance is in the teaching of hearing impaired children to pronounce consonant sounds. Because the acoustic cues in the speech of the hearing impaired are severely distorted, or in some cases absent, the use of acoustic based recognition systems would be either impossible or extremely difficult. In an attempt to address the problem an articulatory based recognition system was developed to recognize the consonant sounds k, s, and t. The recognition system works by separating tongue-palate contact patterns into categories. These patterns were obtained with the use of electropalatography (EPG). Some processing was performed on the data obtained with EPG in order to reduce the amount of data without losing any pertinent information. The processed data was fed into a three layer artificial neural network (NN). The NN was trained using the backpropagation learning rule. Recognition was divided into two tasks, detection and classification. The NN is responsible for the detection of the consonant while duration constraints are responsible for classification. The results obtained indicate that using articulatory data to perform phoneme recognition is a viable option. The overall recognition rate was 95.83%. The recognition rate for the consonants across vowels were 90.63% for k, 96.87 for s, and 100% for t.

ARE WE DONE YET? A LOOK AT DISTRIBUTED TERMINATION DETECTION. Jeff Matocha, Dept. of Computer Science, Univ. of Ala., Tuscaloosa, AL 35187.

An important problem in the field of distributed systems is that of detecting termination of a distributed computation. Distributed termination detection (DTD) is a difficult problem due to the fact that there is no simple way of gaining knowledge of the global state of the system. Of the algorithms proposed in the last fifteen years, there are many similarities. We have categorized these algorithms based on the following factors: algorithm type (e.g. wave, credit-recovery, parental responsibility), required network topology, process symmetry, necessary process knowledge, communication protocol (synchronous or asynchronous), communication channel behavior (FIFO or non-FIFO), algorithm repetition, message optimality, and fault tolerance. This classification is intended to make it easier for one to choose an appropriate DTD algorithm given the needs of their application as well as to serve as a survey for this topic.

COMPUTER GENDER STEREOTYPING: IMPLICATIONS FOR ACADEMIA AND THE WORKPLACE. Mary K. Astone, Sorrell College of Business, C.I.S. Department, Troy State University, Troy, AL 36082.

The gender typing construct for computing is operationalized through the use of a valid, reliable measure called the Gender Typing Scale (GTS). The scale measures college students gender typing perceptions of computing activities. These perceptions are examined in relation to degrees conferred in business information systems, computer and information sciences, and computer engineering. Labor market data for participation in computing careers is examined in light of student perceptions.

Implications of research findings are explored for upper level management, human resource managers, and educators in light of college enrollment figures and labor market participation rates. Suggestions are made to ameliorate the current situation. Recommendations are made for further research.

REUSE OF PROGRAMMING LANGUAGE SEMANTICS. Viswanathan Vaidyanathan, Department of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294. Email: vaidyana@cis.uab.edu

The formal specification of the semantics of programming languages assists in the development of compilers/interpreters for the same. Defining the formal semantics can expose the underlying similarities between apparently different languages and differences between apparently similar languages. A modular approach to representing the denotational semantics of the language, by abstracting out appropriate details to the semantic algebra level, facilitates simple definitions of the semantic functions and also in the reusability of semantics. Semantics of different languages can be defined by inheriting and specializing from an object-oriented specification framework. This amounts to compiler reuse at a specification level. We have studied the reusability of semantics between different languages, namely, subsets of imperative language C, functional language ML and object-oriented language Smalltalk.

This research was supported by a research grant from the Alabama Academy of Science. Thanks also to my advisor Dr. Barrett R. Bryant.

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ALABAMA ACADEMY OF SCIENCE
SPRING EXECUTIVE COMMITTEE MEETING
KELLOGG CONFERENCE CENTER
TUSKEGEE UNIVERSITY, TUSKEGEE, AL
MARCH 6, 1996

A. The meeting was called to order at 6:30 p.m. by President, Dr. Dan Holliman. The minutes of the October 28, 1995 Executive Committee Meeting were approved as distributed.

B. Officers' Reports

1. **Board of Trustees** - Dr. Barker did not present a formal report, but did point out that 9 of the 12 Trustees were present. They included Drs. Barker, Thomas, Sharma, Marion, Barrett, Spencer, Omasta, Moeller and Wilborn.
2. **President** - Dr. Holliman submitted the following report:

Most of my time this year has been spent investigating the problems faced by the Academy. The most pressing ones that I have identified include the following. They are not listed in any order of priority.

- a) Ensuring continuity from one years tenure of the primary officers to that of those corresponding officers for the following year. The Secretary and Treasurer normally serve more that one stint. The Executive Secretary is the sole bridge serving to pass the banner to the next class of officers and committee chairs who are coming in new.
- b) Reducing turn around time for legislative action for Academy affairs. Normally, the executive board meets twice each year to act on pressing issues.
- c) Increasing visibility of the Academy and public awareness of the value of our organization. This is directly related to an attempt to increase membership and provide a forum for public education.
- d) Locating the annual meeting in or close to major population areas of the state, and yet not detract from the publicity and recruiting efforts of other peripherally located colleges and universities.
- e) Discussing the Gorgas Program as remaining part of the Academy.

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Specifically, I have been involved with the following:

- a) The initiation of a fall dinner meeting yearly for the Steering Committee so that more time would be available to fully explore issues, and to quickly render legislative action.
- b) I have submitted to the Committee on Science and Public Policy a cover letter that was approved by the Executive Committee to accompany a booklet concerning evolution to be distributed to local schools.
- c) Upon the recommendation to the Committee on Science and Public Policy I have appointed members for the Scientific Advisory Board for this Committee.
- d) I have attended the 1995 ASTA fall meeting at UAB.
- e) I have personally contacted all of the primary officers and committee chairs, most committee members as well as Section officers either by phone or by mail at the beginning of my tenure.
- f) I have attempted to identify any problems that might be encountered by next year's officers and have discussed possible solutions with them.

Lastly, this President would like to commend the excellent work of Dr. Leven Hazlegrove, our Executive Secretary. He has made my job easy and has served well in this advisory capacity. According to our Constitution and By-Laws, I am recommending that his tenure be extended for as long as he would hold this Office. By copy of this report, I am asking that this motion be approved.

3. **President-Elect - Dr. Tom Jandebeur reported:**

Visited the Academy archives at Auburn University's Draughon Library February 14-15; contributions to our archive have not been made since early 1989; have since spoken by phone with Dwayne Cox, Archivist for the Draughon Library, about developing a plan for systematic contribution by Academy Executive Committee members to the Academy's collection. Visited the Montgomery Visitor's Center on February 16 to pick up brochures advertising Montgomery area attractions for distribution to Academy members attending the Tuskegee University meeting. Solicited input from certain Committee chairpersons and revised handout titled "AAS Organizations and Activities" for distribution at Alabama Science Teachers Association (ASTA) mini-conferences held in Athens and Mobile and for distribution to members attending the Tuskegee

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minutes; represented the Academy at the ASTA mini-conference held at Athens High School, February 17. Corresponded with Area/Section Coordinators listed in 1992 document to solicit their participation in this program for 1995-96; thus far have received 34 positive responses, and continue to work toward re-establishing this communication link for the Academy. Using an HTML editor, have developed a home page and several documents for distribution to Academy members via the Internet; am investigating means to bring the Academy "on-line" late Spring or early Summer.

4. **Second Vice-President** - Dr. Ellen Buckner did not present a formal report. She did, however, introduce a motion to pay \$500 to defray printing and shipping costs for the directory of Visiting Scientists.
5. **Secretary** - Dr. Larry Boots submitted the following report concerning current membership and trends over the past few years.

Membership as of March 5, 1996	571
Membership on October 27, 1995	670
New Members since January 1, 1996	44
Members Deleted due to Non-payment of Dues	154

Trends in Membership:	<u>MEMBERS</u>
April, 1992	728
March, 1993	661
March, 1994	739
March, 1995	650
October, 1995	670
March, 1996	571

MEMBERSHIP BY SECTION

<u>SECTION</u>	<u>OCTOBER 1995</u>	<u>MARCH 1996</u>
I. Biological Science	168	136
II. Chemistry	73	65
III. Geology	24	21
IV. Forestry, Geography, Conserv., Planning	17	15
V. Physics & Mathematics	67	60
VI. Industry & Economics	30	17
VII. Science Education	30	28
VIII. Social Science	36	30

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IX.	Health Science	103	83
X.	Engineering & Computer Science	35	30
XI.	Anthropology	9	8
77.	University Libraries	22	24
88.	High School Libraries	51	51
Unknown		3	3

MEMBERS

Emeritus	29
High School Libraries	51
University Libraries	24
Honorary	8
Individual	370
Student	57
Life	31
Sustaining	1

6. Treasurer - Dr. Larry Krannich reported that:

The Academy operated within the projected 1995 Budget and ended the year with income exceeding expenditures by \$203.06. Actual income was \$2,762.29 less than projected. Although we budgeted \$2,500 in income for the Jr. Academy, for the past few years, there has been no such income. The decrease in support of the Journal was offset by the greater than anticipated revenues from the annual meeting. This decrease was a result of the final contribution checks not being received by the associate editor until December and being deposited in January, 1996. Thus, the 1996 contributions should be higher than budgeted. Contributions to the Mason fund continued to fall short of projections. Also dues income was less than projected. We also have an unexplained income from American Express of \$253.48, because they incorrectly credited us through our account at Colonial Bank. Repeated attempts through the bank and American Express to return the funds have failed, because neither have any record of which account has been incorrectly debited. I assume that this will eventually be corrected by American Express. Expenses were \$7,016.35 less than budgeted, because of the decrease in expenses for the annual meeting, lack of support for workshops, decreased journal printing costs, and decreased officer expenses.

For the first quarter of 1996, our dues income is at the level expected while the contributions for support for the Journal exceed those of last year, as noted above. Our expenses are as expected. Thus, we appear to be keeping within the budget for 1996 and do not anticipate any budgetary problems. Additional budget information is available upon request.

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7. **Journal Editor** - Dr. Bradley reported that:

Thirteen manuscripts were received during the past 12 months. Of these nine have been accepted and four were rejected. The number of published abstracts in the July, 1995 issue was 124, down from 196 in 1994.

January/April 1995 Issue	-	124 Abstracts Minutes
July, 1995 Issue	-	6 Articles Published
October, 1995 Issue	-	3 Articles Published Membership Roll Index

8. **Counselor to AJAS** - Dr. B.J. Bateman submitted that:

The Alabama Junior Academy of Science has a full schedule of activities planned for the annual meeting, including: the paper competition among 40 regional winners, local tours, the caucus and the election of state officers, presentation of awards, and the joint banquet.

At this time, about 90 students and sponsors have pre-registered for the meeting and about 90 plan to attend the joint banquet.

9. **Science Fair Coordinator** - no report was submitted but Dr. Larry Wit requested that an Ad Hoc committee be formed to look into Science Fair participation. Dr. Holliman appointed Dr. Wit, Dr. Omasta, Dr. Boots and Mary Thomaskutty to this committee.

10. **Science Olympiad Coordinator** - Steven Carey submitted the following report:

The Alabama Science Olympiad is currently consists of six Division C (grades 9-12) Science Olympiad tournaments and four Division B (grade 6-9) olympiads. An updated/corrected list of host institutions, regional coordinators, and tournament dates for 1996 is attached. The Division C State Science Olympiad will be held at the University of Mobile on April 20, 1996; the Division B State Science Olympiad will be held at UMS-Wright Preparatory School on April 27, 1996. State winners in both divisions advance to the National Science Olympiad to be hosted by the Georgia Institute of Technology, Atlanta, Georgia on May 17-18, 1996.

Because several regionals have yet to conduct their Science Olympiad tournaments, I do not have final numbers concerning student participation;

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however, the totals statewide will probably be similar to those of past years. There is a fairly strong movement within the state to begin Division A (elementary grades) regionals, and I hope to have a Division A regional infrastructure established by next year.

As State Director, I hope to visit several regional Science Olympiads this year as well as attend the National Science Olympiad and the State Directors Meeting in Atlanta.

The Science Olympiad is a volunteer effort and everyone who gives of their time and expertise to make this program a success deserves the thanks of the Academy.

11. **Counselor to AAAS** - no report.
12. **Section Officers:**
 - I. **Biological Sciences** - Dr. David Nelson reported verbally concerning presentations at the meeting.
 - II. **Chemistry** - no report.
 - III. **Geology** - Dr. David Kopaska-Merkel submitted the following report:

The geology section has a high turn-out at the 1995 meeting and it looks like we might do even better in 1996. Twelve presentations were made last year and 13 are planned for this year. We are also seeing greater student participation, which is very encouraging. Despite the increased meeting participation, our membership has been relatively stable.

Our section vice chair, Dr. David Davies, took a job in Georgia and so had to resign. The new vice chair is Dr. Douglas Haywick, of the Geology and Geography Department at the University of South Alabama. Because this is the end of my term as section chair, Doug also assumes the mantle of section leadership this spring. Because Doug is largely responsible for the increased student participation in our section, I am sure that under his leadership the section will continue to grow.

Our section still represents no more than 10 percent of the geologists in the state. I believe that the primary reason is the fact that the science activities of the Academy are too diffuse. This is to some extent a positive-feedback phenomenon, in which the paucity of geology in the Journal and at the annual meeting keeps geologists from joining, which in turn stifles growth of the section. I do not have a solution for this problem. However, because the most useful activities of the Academy appear to benefit students, outreach to college and university departments might help. This outreach to college and

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university departments might help. This outreach should focus on the activities of the Academy that could help students. Doug will undoubtedly continue to pursue recruiting at the section level, but it may be time for the Academy as a whole to consider more active student recruiting.

IV. Geography, Forestry, Conservation and Planning - Dr. Lisa Keys-Mathews reported that:

The Geography, Forestry, Conservation and Planning Section has thirteen papers for presentation at the 73rd Annual Meeting of the Alabama Academy of Science. This number is twice that of 1995. The increase in papers is partially due to Priscilla Holland's concerted effort to recruit presenters in 1994 and 1995. Priscilla Holland was Section Chair in 1994-95. She contacted various agencies, organizations, universities and colleges requesting paper submissions.

The papers in Geography, Forestry, Conservation and Planning Section offer a wide range of topics including tourism, access to rural health care and the Middle East. In addition, other topics include hyperspectral imagery, environmental monitoring, and socioeconomic analysis. Four students are presenting papers this year, two of which are entered into the student paper competition.

At the request of the Section membership, the Executive Committee voted to change our name to Geography, Forestry, Conservation and Planning. The request was approved and the new Section name is reflected in this year's program.

V. Physics and Mathematics - no report.

VI. Industry and Economics - no report.

VII. Science Education - no report.

VIII. Social Sciences - no report.

IX. Health Sciences - no report.

X. Engineering and Computer Science - no report.

XI. Anthropology - no report.

13. Executive Officer - Dr. Leven Hazlegrove reported that:

Since the Fall Executive Meeting, 10-28-95, SRI, we have been working on the following projects during the last 5 months:

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- 1) Set up and prepared the Gorgas Scholarship Foundation, Inc., Science Talent Search, in cooperation with the Westinghouse Scholarship Ranking Science Service, Inc., D.C. for the Tuskegee University Meeting, March 8, 1996, with the leadership of Dr. Glynn Wheeler, Secretary-Treasurer and Dr. P.C. Sharma, Tuskegee University.
- 2) Mailed by bulk mail 850 Tuskegee University meeting programs for March 6-9, 1996 edited by Dr. William J. Barrett, February 20, 1996.
- 3) Sent development letters to 4 industrial companies and foundations with positive reply from one.
- 4) Assembled, edited and prepared for bulk mail 900, Tuskegee University "Call for Papers" for Tuskegee University meeting March 6-9, 1996, with the able assistance of Ms. Karen Waits and Ms. Tammie Wyatt, Chemistry, UAB, 975-7821.
- 5) Sent hand written notes to 50 outstanding Scientist and Engineers, Mathematicians, and potential members whose "write-up" appeared in local publications. (20 New Members!!)
- 6) Met twice with Dr. Adriane Ludwick, Professor and Chair of Chemistry and her local committee for the 1996 AAS dates: March 6-9, 1996.
- 7) Set up ASTA booth at UAB Arena, September 7-9, 1995 with the able supervision of Dr. William J. Barrett, Dr. Dan Holliman, Dr. Tom Jandebour and Dr. Ellen Buckner.
- 8) Prepared 350 abstract forms for the Tuskegee University meeting, March 6-9, 1996 for eleven section chairs.
- 9) Moved the AAS Executive Director's office to the Chemistry Department (901 14th Street South - CHEM 201); new phone (205)934-4747, FAX (205)934-2543.
- 10) Your Director studied flora, fauna and pollution in USA, February 13-16, 1996 with the Alabama Fisheries Association, Gulf State Park.
- 11) Set-up the 74th Annual Meeting with the able direction of Dr. Tom Vocino, Professor of Political Science, Auburn University in Montgomery, Montgomery, AL, March 19-22, 1997.
- 12) Set-up with Dr. David Nelson's able help the 1997 meeting at AUM with a kind invitation of Chancellor Roy H. Saigo, (334)244-3696.

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C. Committee Reports

1. **Local Arrangements** - Dr. Adriane Ludwick reported verbally that the arrangements were progressing as planned and everything was going well.
2. **Finance** - Dr. Barker summarized the Academies' financial prospects in his report:

Monotonous though it may be, it again is a pleasure to report that the annual turnover of some \$25,000 to \$30,000 in Academy finances shows a slight positive balance of \$203 for 1995.

Again, it is well worth the time to study the Treasurer's quarterly breakdown of income and expenses, since that emphasizes the futility of forecasting our financial status on much less than a yearly basis. For example, I do not believe it is worthwhile to become euphoric about the balance (as of March 4, 1996) of income over expenses because both figures are greatly below those of the previous 4 years.

Nonetheless, we can hope for another successful year in 1996.

ALABAMA ACADEMY OF SCIENCE FINANCES (AS OF MARCH 4, 1996) Summarized for 12 months of 1992-95 & 2 months of 1996

12-Month Budgeted Income & Expenses

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Income:	\$24,500	\$29,170	\$28,500	\$28,500	\$25,700
Expenses:	<u>32,170</u>	<u>35,125</u>	<u>31,951</u>	<u>32,551</u>	<u>29,500</u>
Balance	-7,670	-5,955	-3,451	-4,051	-3,890

10-Month Actual Income & Expenses

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u> <u>(2 month actual)</u>
Income:	\$12,958	\$17,115	\$19,108	\$18,578	\$8,333
Expenses:	<u>22,980</u>	<u>25,973</u>	<u>22,398</u>	<u>22,769</u>	<u>1,058</u>
Balance	-10,022	-8,858	-3,290	-4,191	+7,275

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12-Month Actual Income & Expenses

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>
Income:	\$26,996	\$28,253	\$30,793	\$25,738
Expenses:	<u>25,975</u>	<u>27,725</u>	<u>24,204</u>	<u>25,535</u>
Balance	+1,021	+528	+6,589	+203

3. **Membership** - no report.

4. **Research** - Dr. Richard Hudiburg reported that:

The Chairperson of the Committee on Research received 38 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards. The later deadline of **February 1** seems to have generated more requests. There was little difficulty in processing these requests. There was some confusion by some of the requesters to where they should direct the request. It is requested that members advise their students to the correct procedures for applying for these competitions. E-mail has facilitated some of the requests and cut down on response time.

Six travel grants were awarded. A total of 18 papers and 1 poster, covering 6 of the AAS sections, are entered in the Student Research Grants. The section Vice-Chairpersons will provide the names of his/her competition winners to the Chairperson of the Committee on Research before the annual meeting banquet scheduled for March 9. The awards in a section can be split between co-winners according to decision of the judges.

5. **Long-Range Planning** - Dr. Ken Marion reported as follows:

The Committee considered a list of items generated from an informal discussion at a dinner of the Executive Committee held the night before the Fall 1995 AAS Executive Committee meeting. We were charged by President Holliman to explore the major issues discussed at this dinner meeting and to have a report ready on these issues for the Spring 1996 AAS annual meeting. In addition, the first two items listed below were a direct charge from President Holliman.

- a) Do we need a standing committee appointed for a quick response to important issues? This was a recommendation of the Science and Public Policy Committee in its Fall 1995 report. At times, quick responses are often needed. These responses can not often wait for the two formal meetings per year of the AAS. The Planning Committee was of the opinion that the Steering Committee is the appropriate body for quick response. It has the apparent authority to act within limits.

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- b) Do we need a standing committee on environmental issues? The Science and Public Policy Committee recommended in its Fall 1995 report that an expert committee be charged with identifying important environmental issues and responding to them. The Long-Range Planning Committee suggests, that awhile an Ad Hoc Committee can be formed, an expansion of the Science and Public Policy Committee to include environmental experts would be the most logical way to go. Environmental issues could then be handled within the context of the Science and Public Policy Committee.
- c) Should there be a By-Laws change to make the terms of office two years for the President and President-Elect? This would require a restructuring of the present procedures. There was some sentiment in the Committee for a two-year term of office. The President just starts to "know the ropes" when his/her term ends. On the other hand, this duration of office may not be favorable for recruiting officers. Further, there is some sense of loyalty and dedication to an organization when people are former office holders. One-year terms cycle these individuals through rapidly. Another suggestion made was to restructure the duties of the President-Elect and Second Vice-President in order to give them more familiarity with the functioning of the Academy. The Committee suggests that, upon favorable discussion by the Executive Committee, that this item be explored in further depth in the near future.
6. **Auditing - Sr. Academy - no report.**
7. **Auditing - Jr. Academy - no report.**
8. **Editorial Board and Associated Journal Editors - The following was submitted:**

Annual Report of the
Associate Editor for Business Affairs
Journal of the Alabama Academy of Science
March 6, 1996

I am pleased to report that 13 Benefactors of the Journal have contributed \$4,050 this past year to help defray publication costs. Regrettably, T.V.A. has not continued their support of the Journal. I continue to look for ways to increase the number of Benefactors of the Journal.

9. **Place and Date of Meeting - Dr. David Nelson reported that:**

The following sites have been previously approved by the Executive Committee of the AAS:

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1997 - Auburn University Montgomery (third week in March)

1998 - University of South Alabama

Following a 4-year cycle adopted by our committee a few years ago, we have attempted to rotate meeting sites once in the north, once in the south and twice in the interior of the state. Next we are due to meet in the northern part of the state. Tom Jandebaur has expressed a desire for us to meet at Athens State College (providing that their proposed conference center is constructed). This would be our first meeting there.

The committee recommends that we approach Athens State College about meeting there in 1999 (pending construction of their conference center). If this is not possible/advisable, we should consider UNA (met there in 1987), Auburn (met there in 1988) or JSU (met there in 1991).

10. **Newsletter** - no report.

11. **Public Relations** - no report.

12. **Archives** - Dr. Troy Best reported that no requests had been made during 1996 for archival materials.

13. **Science and Public Policy** - Dr. John Frandsen reported on this committee's activities as follows:

Science Education in the Public Schools - A pantomime by the Governor and President of the Board, wherein he played an ape, set the stage for consideration of the science textbook list by the State Board of Education at its November 9 meeting. As expected, the Eagle Forum of Alabama and its allies were strongly represented, resulting in loud applause for all speakers supporting their position, and an absence of applause for those presenting other viewpoints. Many members of the audience were wearing round, paper "buttons", 2 1/2 to 3 in. diameter, with black printing on a white background. Horizontally, across the face was the word "Don't", followed by a much larger "Monkey" below it. Around the edges were the words "with my kids". The Governor absented himself from this portion of the Board meeting - having another engagement - leaving the Vice-President, Dr. Ethel Hall, as presiding officer.

During the time reserved for public comment, each speaker was limited to two minutes. Eight were on the list to speak in favor of adoption of the list of approved texts as drafted; 14 were to speak against the adoption (the position of the Eagle Forum). Among the "anti" speakers were several "scientists" of various stripes, "concerned" parents, and several Fundamentalist preachers. The Chair of this committee read the following statement in support of adoption of the list:

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Governor James, Honorable Members of the Board:

I shall confine my presentation to 15 statements of fact:

- 1) If science is to be taught, the texts used should contain science and only science.
- 2) Biology is a science.
- 3) Evolutionary theory is an integral, essential part of biology.
- 4) Biologists agree that evolution has occurred and is occurring, and that it is the only explanation for the present diversity of organic structure and function supported by sound, scientific evidence.
- 5) There is no scientific evidence that evolution has not occurred.
- 6) Disagreement - and even controversy - among biologists is confined entirely to the mechanisms of evolution.
- 7) There is today no more reason to question the occurrence of organic evolution than there is to question the occurrence of gravity.
- 8) The occurrence of organic evolution is in accord with the laws of natural science, including those of thermodynamics, for the system within which evolution occurs receives a constant supply of energy from the sun.
- 9) This energy from the sun fuels the creation of increased order.
- 10) Since evolution is fully as scientifically credible as gravity, the laws of thermodynamics, the principles of quantum mechanics, and the rules of chemical bonding, there is no more reason to place cautionary disclaimers in biology texts than there is to place them in texts for the other natural sciences.
- 11) We live in a culturally-diverse secular society.
- 12) There is no compelling secular reason for the Board of Education to single-out biology texts for special scrutiny or for the inclusion of disclaimers cautioning their readers against their contents.
- 13) The reasons some members of our society demand such special treatment for biology texts are not secular; they are religious, and purely so: evolution does not make these people comfortable with their Bible.

- 14) Many of our citizens who are devout Christians do not support these demands: for them, the process of evolution bears witness to Divine will.
- 15) In a secular society, the state must not impose religious standards if that society is to maintain its secular character, and if its religiously diverse components are to coexist in a peaceful and orderly manner.

Following the period for public comment, the Board voted to adopt the recommended list of texts less the BSCS one. It also voted to require that the following insert be placed in each biology text used in the public schools:

A MESSAGE FROM THE ALABAMA STATE BOARD OF EDUCATION

This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals and humans.

No one was present when life first appeared on earth. Therefore, any statement about life's origins should be considered as theory, not fact.

The word "evolution" may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, may "evolve" into gray moths.) This process is microevolution, which can be observed and described as fact. Evolution may also refer to the change of one living thing to another, such as reptiles into birds. This process, called macroevolution, has never been observed and should be considered a theory. Evolution also refers to the unproven belief that random, undirected forces produced a world of living things.

There are many unanswered questions about the origin of life which are not mentioned in your textbook, including:

- Why did the major groups of animals suddenly appear in the fossil record (known as the "Cambrian Explosion")?
- Why have no new major groups of living things appeared in the fossil record for a long time?
- Why do major groups of plants and animals have no transitional forms in the fossil record?
- How did you and all living things come to possess such a complete and complex set of "instructions" for building a living body?
- Study hard and keep an open mind. Someday, you may contribute to the theories of how living things appeared on earth.

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It is our understanding that several organizations are studying this insert to determine if it would be likely to survive a court test as to its compliance with the Establishment Clause of the First Amendment.

COURSE OF STUDY: HEALTH SCIENCES

The Course of Study: Health Sciences committee will be named this spring, as yet another area of instruction in the public schools comes up for review. This area includes sex education and AIDS prevention. As for the Course of Study: Science Committee, most of the members of this one will be selected de facto by the State Superintendent of Education according to a complex formula apportioning membership among professional educators from the several grade levels and the congressional districts. Several members, who cannot be active educators, will be named by the Governor. We have encouraged several well-qualified individuals to submit their resumes to the Governor with a request to be considered for appointment. Believing that inferred sponsorship by the Academy would be counterproductive, we have not submitted names directly to the Governor for his consideration.

We believe it probable that the same coalition spearheaded by the Eagle Forum of Alabama - that opposed teaching of evolution in the public schools as "factual" will play a strong role in determining the content of the Course of Study: Health Sciences. Based on sex education curricula proposed everywhere, we fear that the one supported by this coalition will contain erroneous statements regarding the prophylaxis and treatment of sexually-transmitted diseases, and the scientific basis of contraceptive methods. This committee will maintain an active interest in this Course of Study as it is developed, and will make its objections known if it contains statements and requirements that are not scientifically sound.

PRESENT PRIORITIES FOR THIS COMMITTEE

At our January meeting, in Auburn, we decided that our first priority should now be to establish and develop contacts with other groups and organizations in the state who share a common interest in the quality and fidelity of science education in the public schools. The goal of this intercourse is to increase our influence with elected officials, especially those who serve in the Legislature and on the State Board of Education. During the coming year, we intend to host several small conferences with representatives to these groups to identify common interests and map our strategy for achieving this goal.

We shall continue to carefully monitor science education and other matters within our proper purview.

DISTRIBUTION OF NAS BOOKLETS TO SUPERINTENDENTS

These booklets have been purchased and will be mailed - in accordance with the directions of the Executive Committee - just as soon as administrative details of the joint

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cover letter from the Academy and the Alabama Science Teachers' Association have been finalized. This is expected to occur within the next few days.

14. **Gardner Award** - no report.

15. **Carmichael Award** - Dr. Sahi reported that:

The Emmett B. Carmichael Award Committee has recommended the article "THE EFFECTS OF VARYING SALINITIES ON POLYAMINE LEVELS AND THEIR RELATION TO NA+K+ATPASE DURING EARLY DEVELOPMENT IN THE BRINE SHRIMP ARTEMIA FRANCISCANA" by Drs. Kara J. Lee and Stephen A. Watts as an outstanding paper published in the **Journal** in 1995.

16. **Resolutions** - Dr. Gerald Regan submitted the following resolutions:

Be it resolved by the executive committee that the following script be employed at the appropriate time:

(PRESENTATIONS AT THE ANNUAL BANQUET)

Each year the Academy recognizes individuals who have served the Academy in an exceptional manner.

1) First and foremost we recognize:

Benjamin F. Payton, President of Tuskegee University for graciously hosting the 73rd annual meeting of the Alabama Academy of Science.

2) The Academy would also like to recognize:

Adriane C. Ludwick, chairperson of the local arrangements committee for the many weeks of planning and hard work that enabled us to have this very successful annual meeting.

3) Lastly, the Academy thanks Dan C. Holliman for his able leadership of the Academy during the past year.

DEATHS

The Academy would like to take a moment to recognize the following member of the Academy whom it has lost through death over the past year: Morris Cecil Mayfield

His loss and the loss of others about whom we have not yet learned is a loss to science and to education and we mourn their passing.

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It was also requested that the editor of the newsletter publish regularly a brief notice inviting the members to send notices of deaths of members of the Academy to the Committee on Resolutions.

17. **Nominating Committee** - Dr. Ellen Buckner and her committee are currently working on the list of new officers.
18. **Mason Scholarship** - Dr. Moeller reported that applicants were being reviewed.
19. **Gorgas Scholarship** - no report.

D. **Old Business** - A motion was submitted by Dr. Barker (seconded by Dr. Jandebeur) to undertake discussions with Gorgas as to merge their program with the Academy.

The details of discussions leading up to this motion are summarized below. A more detailed report can be obtained upon request. The motion passed.

As summarized by Dr. William J. Barrett, it may be suitable, or even necessary, for the Gorgas Scholarship Foundation's activities in support of science education and related areas to be merged with those of an organization clearly designated by the Internal Revenue Service as a Public Charity. The Alabama Academy of Science seems to be an eligible and appropriate body to undertake this responsibility, provided the many essential details can be negotiated between the Academy and the Foundation.

It is hereby moved that the Alabama Academy Executive Committee authorize the ad hoc Committee appointed on October 3, 1995 by President Dan C. Holliman, (Dr. Samuel B. Barker, Dr. William J. Barrett, co-chairman, Dr. Kenneth Dillon, Dr. Leven Hazelgrove, Dr. Holliman, and Dr. Glynn P. Wheeler, co-chairman), plus three members of the Alabama Board of Trustees, to undertake discussions with the Gorgas Scholarship Foundation Board of Trustees to determine specific details of implementation of a suitable merger to the two organizations. An indication of the Academy's readiness to participate should be made promptly by the co-chairmen.

- E. **New Business** - none.
- F. **Meeting was adjourned.**

ALABAMA WINNERS
FROM
THE 1996 INTERNATIONAL SCIENCE AND ENGINEERING FAIR
TUCSON, AZ

1. *Jeremiah Brown* - Covenant Christian Academy, Huntsville, AL.
 - a. Computer Science: Honorable Mention for *Genetic Algorithm Opimization of Lenses Using the Y-Ybar Diagram: Phase II*
 - b. *Optical Society of America* - Second place special award (\$200.00), student membership in OSA, one year subscription to *Physics Today and Optics and Photonics News*
 - c. *U. S. Air Force* - \$1,500.00 award, medallion and certificate
2. *Ryan Williams* - Alabama School of Math and Science, Mobile, AL.
 - a. Third place special award from the *National Taiwan Science Education Centre* - \$200.00 award and a certificate
 - b. Computer Science third place category award for *Algorithm for Optimal Compression of High Entropy Data* - \$1000.00 award
3. *Dorek Biglari* - Covenant Christian Academy, Huntsville, AL.
 - a. *Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society* - First place special award (\$150.00)_
 - b. *Society of Exploration Geophysicists* - Award of merit for *Lateral Stabilization of the Multi-Axis Magnetic Suspension Seismometer*. Receives a subscription to the Society' two publication: *Geophysics* and *The Leading Edge*. Winner's instructor will also receive certificate.
4. *Ehren Biglari* - Covenant Christian Academy, Huntsville, AL.
 - a. Upsilon Pi Epsilon, the National Computer Science Honor Society - Honorable Mention award of \$100.00 for *Statistical Analysis of the Human Voice*. School of winner will also receive plaque.
5. *Stephen Cooper* - Bradshaw High School, Florence, AL
 - a. Engineering Category Third place award of \$1000.00 for *Bench Scale Thermal Desorption Decontamination System*

International Science and Engineering Fair

6. *Kwabena Larrey Blankson* - The Altamont School, Birmingham, AL
 - a. Medicine and Health Third place award for *In vitro Antibacterial Effects of the West African Chewing Stick and Sponge on Mutans Streptococci*
\$250.00

Total money awarded

\$4,400.00

Mary Thomaskutty

Notes

Notes

Notes

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Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. Larry R. Boots, Department of Obstetrics & Gynecology, University of Alabama, Birmingham, AL 35294. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics; Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the *Journal* implies that it has not been published previously and that it is not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

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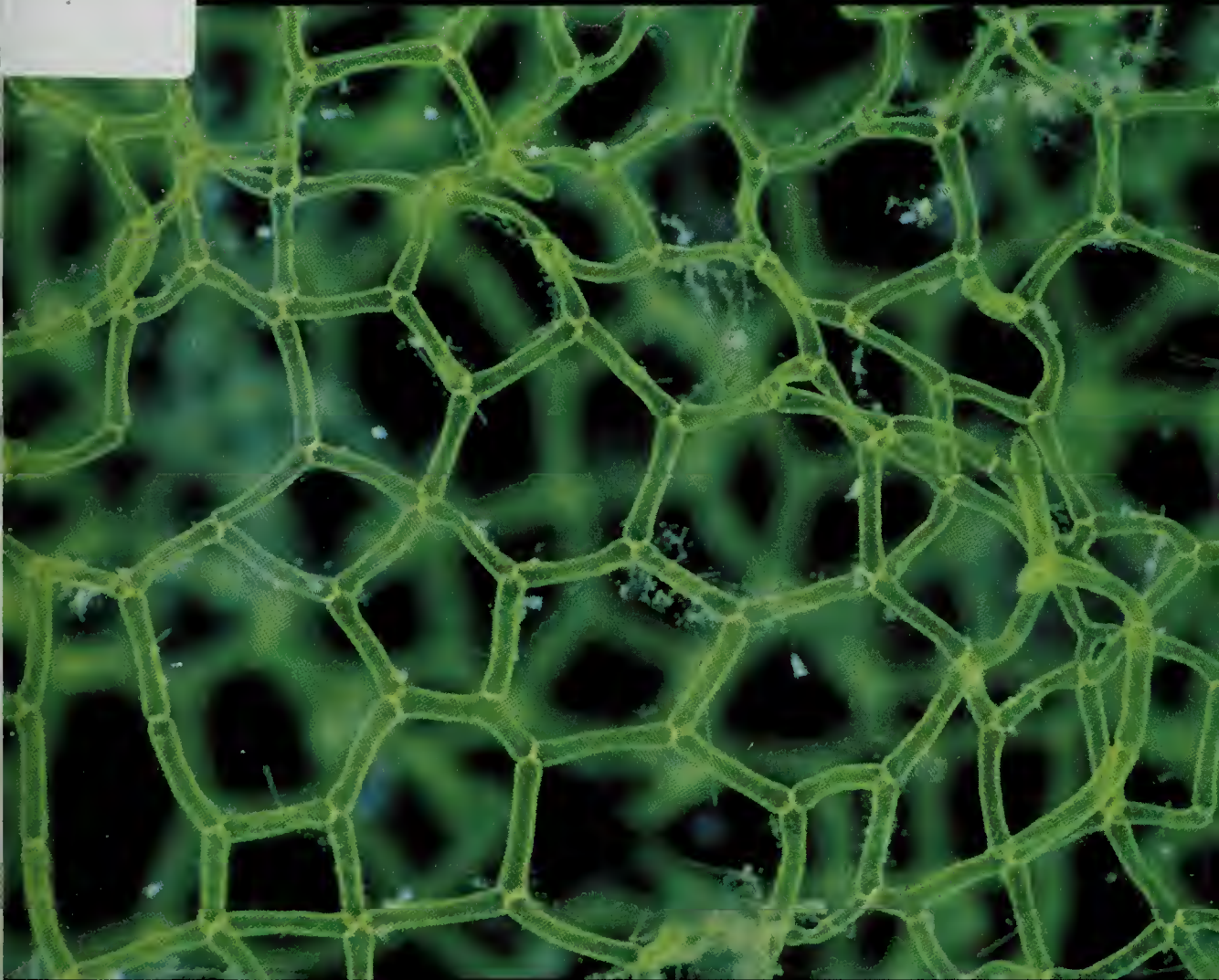
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COVER PHOTOGRAPH: *Vorticella* and other protozoa can be seen in this photograph, attached to cells of the green alga, *Hydrodictyon reticulatum*. Algal mats of different species harbor significantly different micro- and macrofauna (see article p. 158). Photograph by Debbie Folkerts.

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THE WORLD'S LARGEST STAND OF NEEDLE PALM
(*Rhapidophyllum hystrix*): A BRIEF BIOLOGY

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INTRODUCTION

Needle palm, *Rhapidophyllum hystrix* (Pursh) H. Wendl. & Drude, is one of five palm species that occur in temperate southeastern North America. The genus is a monotypic member of the subfamily Coryphoideae, tribe Corypheae, subtribe Thrinacinae. The most closely related genus, *Trachycarpus*, occurs in Southeast Asia (Uhl and Dransfield 1987). Thus, *Rhapidophyllum* seems to be a geographical relict.

Needle palm ranges from south central Florida north to the southeastern corner of South Carolina and west to southeastern Mississippi. Most of the localities lie on the Coastal Plain but in central Georgia the plant occurs a few miles above the Fall Line at several sites (Clancy and Sullivan 1990a). The species is perhaps the most cold hardy palm (Manley 1967, Popenoe 1973).

Like most palm species, needle palm has been exploited in both the foliage and nursery trades. Harper (1906, 1928) reported the harvest and eventual extinction of this species in the vicinity of Evergreen, Alabama. Although formerly considered to be rare (Ayensu and DeFilipps 1978), the plant is more common than previously realized by many workers and presently has no federal protected status.

Rhapidophyllum hystrix occurs mainly in mesic ravines, mesic hammocks, bottomlands, and similar habitats. Almost invariably, it occurs in sites with partial or heavy shade. Although many of the known sites support only one specimen (Clancy and Sullivan 1990b), there are a number of large populations, and "a few may contain several thousand plants" (Clancy and Sullivan 1990b).

In the summer of 1964, the senior author discovered what appears to be the worlds largest population of needle palm. Because alteration of habitats which support needle palm has accelerated in the past decade, and because a number of large populations in Alabama have been extirpated or decimated by clearcutting of bottomland forests, basic information on this extant large population is presented here.

¹Manuscript received 10 August 1996; accepted 30 September 1996.

DESCRIPTION OF THE SITE

The population described inhabits an area near Crawford, Russell County, Alabama. The area is bordered on the south by a medium-sized creek and on the north by a tributary of the creek. The eastern point considered in our study is marked by the confluence of the two watercourses. To the west of the area, roadfill damming accentuated by beaver (*Castor canadensis*) activity, has killed the bottomland forest and converted the area to marsh. In the 1960s, a few needle palms survived in this area. Before the construction of the road many were probably present. A few needle palms (less than one thousand) still exist on the south side of the larger creek, but the dense population present there several decades ago has been essentially destroyed by grazing, cattle having eaten all developing seedlings for at least the past decade.

Elevation at the site averages about 300 feet above mean sea level. In most years, the entire area is inundated as water rises in the watercourses as a result of heavy spring rains. Many scour pools and small oxbows are present, some retaining water throughout most of the year.

The forest in the area is typical for creek bottoms in the upper Coastal Plain. Overstory trees include more than 20 species, the most abundant being swamp chestnut oak (*Quercus michauxii*), water oak (*Q. nigra*), overcup oak (*Q. lyrata*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), American beech (*Fagus grandifolia*), and spruce pine (*Pinus glabra*). The understory is dominated by ironwood (*Carpinus caroliniana*). Needle palm is the most abundant species in the shrub level, but swamp palm (*Sabal minor*) is present as scattered specimens.

The fauna is typical of stream bottomlands of the upper Coastal Plain. Beaver are very abundant and forage throughout much of the area. White-tailed deer (*Odocoileus virginiana*) are common. Other common mammals include the gray squirrel (*Sciurus carolinensis*) and the swamp rabbit (*Sylvilagus aquaticus*).

METHODS

The area occupied by the relatively dense stand of needle palms was used as area for intensive study in the summer of 1991. Its boundaries were determined by extensive examination of the area on foot. By this method, an area of 37.16 ha was selected to be sampled and examined more intensively. This area excluded the northerly portion of the area between the two creeks because flooding of the tributary and beaver activity have essentially wiped out the palms in the area. The grazed area south of the larger creek was also excluded.

Five square plots were established to obtain information on plant density and population size. Each plot measured 20m on a side (400m²). This size was deemed large enough to yield reliable data but small enough to enable counts of specimens in a reasonable length of time. The plots were positioned by selecting a site for the first plot and positioning the three other plots by pacing away from the center of the east edge of the previous plot a randomly generated number of steps (far enough to ensure non-overlapping plots) in a randomly selected easterly compass direction. At the resulting point, a new plot was positioned by randomly designating the point as one of the four plot corners (northeast, northwest, southeast, southwest). Sides of the plots followed the cardinal compass directions. Totally, the five plots occupied 2000m², or approximately 0.54 percent of the intensively studied area of 37.16ha. Plot boundaries were marked with cotton string and flagging. Wooden stakes were used at the corners unless a component of the natural woody vegetation sufficed.

After plot establishment, the total number of individuals in each plot was counted. All individuals of all sizes were counted including the smallest seedlings that could be detected. Four complete counts of each plot were made, two by each of two different individuals. A mean of the four numbers generated by this procedure was obtained for each plot.

Separate counts were made of the number of seedlings in each plot. A plant was considered to be a seedling if the fronds were undivided. The same procedure was followed in making seedling counts as was used in counting the total number of plants. The number of post-seedling plants per plot was determined by taking the total number of plants per plot and subtracting the number of seedlings from that number.

Separate counts were also made to determine the number of plants that had produced fruit. During these counts, it was necessary to closely examine the base of each palm clump because on many smaller plants, the fruits were covered by detritus, mainly fallen leaves and sifted down flood wrack, that had accumulated around the basal portion. On larger plants the fruit was more easily seen. Again, four separate counts, using the method described, were taken in each plot. The number of fruit clusters and male inflorescences per plant was counted during this process. Because fruit cluster size appeared to vary a count of four randomly chosen clusters was made to obtain a general idea of the number of fruits per cluster.

Using the same methodology, separate counts were made to determine the number of plants bearing male inflorescences. This was accomplished by counting the dried inflorescences remaining on the plant from past flowering episodes. The amount of decomposition and discoloration present allowed differentiation between the inflorescences produced in the spring of the current year and those produced during previous years. Only those of the current year were counted.

The World's Largest Stand of Needle Palm

The mean number of plants, seedlings, plants with male inflorescences, plants in fruit, and post-seedling plants per plot were calculated using data from the means generated by sampling each of the five plots. Using the total area of the study area (37.16ha) and dividing by the plot size (400square meters) a multiplication factor of 929 was determined. These numbers were then used in the determination of totals for the entire study area.

During the many visits to the site from 1990 to 1996, a number of other observations were made. Changes in plant growth and morphology during development were recorded. Notes were made on the characteristics of seed germination sites and of sites in which seedling growth was occurring. Observations on the morphology of plant portions below the ground were made by completely excavating several mature plants and examining and photographing them in detail. A number of seedling plants and small post-seedling plants were also excavated to make observations on their root systems. Observations were also made on pollinators, herbivory, causes of mortality, and other factors important to an understanding the biology of the palms.

RESULTS AND DISCUSSION

Population Characteristics

Data on the counts in the five plots are presented in Table 1. The total number of needle palms of all ages and sizes in the area is estimated at 90,113. Of this number, 71,161 specimens are estimated to be post-seedling individuals and 18,952 are estimated to be seedlings.

Means of counts of post-seedling palms per plot ranged from 43 in Plot 3 to 125.5 in Plot 4 (Table 1). This variation seemed to be a result of variation in habitat conditions. Plot 3 had a large area of mud flat which lacked palms. Lower counts in Plots 2 and 5 are also explainable on the basis of amount of area that received heavy or long-lasting flooding. Plot 2 was split by an old meander of Uchee Creek. The area nearest the meander essentially lacked palms. Plot 1 had a scattered population of palms, less dense than that of Plot 4, but the reasons were not readily apparent.

The largest mature palms in the study area have trunks (needle palm should probably not be thought of as acaulescent) approximately 110cm tall. A number of these specimens have nearly 40 living leaves in the crown. Many specimens with 30 or more living leaves in the crown are present.

Means of counts of seedling needle palms per plot ranged from a high of 38.5 in Plot 2 to a low of 5.0 in Plot 3. High or dense populations of post-seedling plants were not always associated with dense seedling populations, although Plot 3 was lowest in both categories. Plot four, which had the highest number of post-seedling plants had only the

Table 1. Summary of Plot Sample Data on Needle Palms (Rhapidophyllum hystrix) from a site in Russell County, Alabama.

Plot No.	Total Plants	Total Post- Seedlings	Total Seedlings	Total with ♂ Inflorescences	Total with Fruit
1	70	54.5	15.5	22	5
2	130	91.5	38.5	15	10
3	48	43	5	3	0
4	144.5	125.5	19	27	9
5	92.5	68.5	24	13	8
Total	484.75	383	102	80	32
Mean	97	76.6	20.4	16	6.4

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third highest number of seedlings. This may reflect the amount of shade resulting from the presence of the larger plants (see later portion on seedling habitat). Plot 5 had the second highest mean number of seedlings (24), many of which were present in a disturbed area near the root wad of a fallen tree.

Reproductive Features

Flowering at our study site generally occurs in mid to late April. Flowering time seems to be affected by temperature, occurring later in years in which late winter and early spring temperatures are cooler. Moore and Uhl (1982) listed *Rhapidophyllum* as protandrous. We have not observed a conspicuous tendency for male flowers to be produced earlier in this population.

During all years of our intensive observations, weevils, apparently the sole pollinators of this species, have been very abundant on the inflorescences. In one case, more than 20 weevils were present in one staminate inflorescence. It seems unlikely that low pollinator numbers limit fruit set in this species. The life history of this pollinator, an undescribed species of the weevil genus *Notolomus*, related to *N. basalis*, is unknown. The abundance of individuals on the inflorescences of transplanted specimens may indicate that overwintering occurs among the leaf bases of the palms (William Reynolds, pers. comm.). Shuey and Wonderlin (1977) described aspects of the pollination biology of this species.

An estimated 14,864 plants within the study area bore male inflorescences. The mean of all five plots was 16. Mean values for the five plots ranged from a low of 3.0 in Plot 3 to 27 in Plot 4. Numbers of plants with male inflorescences seemed to be positively correlated with total numbers of post-seedling plants, but the correlation was not perfect. Although plot 2 had the second highest mean number of post-seedling plants (91.5), only 15 had male inflorescences in contrast to 22 having male inflorescences in Plot 1, which only had a mean of 54.5 post-seedling plants. The stand in Plot 1 may have supported more seedlings because it was more open and less disturbed by flooding than that in Plot 2. Other than this, biological reasons for the difference remain obscure.

The percentage of post-seedling plants bearing male inflorescences ranged from 6.9% in Plot 3 to 40.3% in Plot 1. Here again the percentage bearing male inflorescences seems to be related to habitat conditions. The number of male inflorescences per plant ranged from 1 to 4 with a mean of 1.8 in 79 plants examined.

Fruit bearing plants in the study area were estimated at 5,946. The mean for all plots was 4. Mean numbers per plot ranged from none in Plot 3 to 10 in Plot 2. The percentage of plants producing fruit ranged from 0.0 in plot 3 to 11.6% in Plot 5. With the exception of Plot 3, all other values were above 7.2%. The absence of fruiting plants in Plot 3 may reflect the high levels of flooding disturbance in the plot, but the numbers

of plants bearing fruit was too low in any plots to allow us to arrive at firm conclusions about reasons for the differences.

It seems clear, however, that fewer plants produce female inflorescences than produce male inflorescences. Totally 20.9% of the plants sampled bore male inflorescences, whereas only 8.4% bore fruit (indicating the earlier presence of a female inflorescence). It is possible, though unlikely, that more female inflorescences were formed than eventually bore fruit. In subsequent years we have found no female inflorescences that had not produced at least some fruits.

Although *Rhapidophyllum* is basically a polygamodioecious species, some monoecious plants occur. Unfortunately, data on numbers of plants bearing both male and female inflorescences was not retrieved during the intensive sampling in 1991. A 1993 200m transect revealed that only 2 of 22 plants bearing flowers had inflorescences of both sexes. However, our experience at this site and others indicates that the percent of monoecious plants is usually higher than this. The presence of plants with flowers of both sexes and the fact that male inflorescences tend to occur on smaller plants than do female inflorescences points to the possibility that *Rhapidophyllum* is protandrous, younger individuals being male and older ones becoming functional females. Clancy and Sullivan (1990b), citing personal communication from H. O. Whittier, alluded to this possibility. It is possible that monoecious plants are those in transitional stages and will eventually become female.

Considerable variation existed in the numbers of fruits produced by female inflorescences. Fruit number ranged from 87 to 168 fruits per cluster with a mean of 126 in four clusters counted. Numbers of clusters ranged from 1 to 3 per plant, larger plants characteristically having more clusters than smaller ones. Oyama (1990) found that number of inflorescences produced was positively correlated with the height of the plant in *Chamaedorea tepejilote*, a neotropical palm. Many of the needle palms that produce inflorescences do not flower every year. We do not have adequate data to hypothesize on the frequency of flowering but have followed one plant that flowered in 1991 and has not flowered since (through the 1996 season). Shuey and Wonderlin (1977) and Clancy and Sullivan (1990b) also commented on flowering irregularity and presented more information than we have been able to gather.

Seedling Habitat

Seedling habitat at this site included all microsites above the waterline of semi-permanent pools or water-logged mud flats. Seedlings are most abundant in two microsites, areas formed by deposition of sandy alluvium and sites where structure (mainly trees and logs) resulted in the deposition of detritus carried by the water. In a number of instances, we noticed that seedlings developed between the buttresses of beech trees. High numbers of seedlings were often found in disturbed soil associated with root wads of fallen trees. Seedling growth and establishment may be enhanced at the edges

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of light gaps as has been found in some tropical species (Chazdon 1986). In contrast to the findings of Clancy and Sullivan (1990b), numerous plants of all stages between seedling and sexually mature specimens were present. One of the sites studied by Clancy and Sullivan, in Monroe County, Alabama has been subject to disturbance by wild pigs (*Sus scrofa*) for several decades, perhaps partially explaining low seedling numbers.

There is strong evidence that fruits are dispersed by flooding. First, the sites in which the seedlings develop are often too far from a fruit-producing mature plant to have been dispersed to the site by gravity alone. Second, needle palm fruits have been seen being carried by flood waters. Third, seedling sites are usually sites where deposition of materials borne by floodwaters has occurred. Clancy and Sullivan (1990b) found no evidence of seedling establishment away from the vicinity of parent plants at their Mississippi site. Even though the site they studied was a "floodplain" it may be that flooding seldom or ever occurred. They referred to the soils at the site as "well drained."

We also frequently found seedlings at the base of female plants. Clearly some dispersal occurs by gravity alone. However, in contrast to the findings of Clancy and Sullivan (1988, 1990b), there were very few instances in which seedlings had sprouted among the leaf bases of parent plants. The extensive flooding which occurs almost every year at our site probably removes most fruits from the plant bases.

Seedlings developing near a parent plant could be confused with vegetative buds from the base of the parent. Several seedlings near but not immediately adjacent to the base of larger specimens were excavated and showed no attachment to the larger specimens, indicating that they were not the result of clonal growth. Clusters arising from separate plants growing together could be confused with clones. On the other hand, William Reynolds (pers. comm) has found that ramets may sometimes appear at distances of nearly a meter from parent plants, giving the impression that they are genetically distinct individuals. Thus, ramets may also be mistakenly interpreted as solitary individuals.

Many of the post-seedling plants at the site were sympodial (caespitose), consisting of clumps of stems resulting from basal subterranean buds. Numbers of ramets in clones produced by this fashion ranged as high as 18. Although plants consisting of solitary stems may often be specimens that have never produced branches, they often appear to be remnant ramets of a clone in which the other ramets have died or in which stems have become widely separated as a result of the death of spatially intermediate ramets. We base this assumption on the fact that many large solitary specimens have stems that partially recline at the base, a characteristic of specimens produced at the edges of large clones.

Mortality Factors

A number of mortality factors and causes of damage to plants were found during this study. Herbivores on needle palm are not common and few plants are conspicuously damaged by insects. However, at this site, beavers damage large numbers of plants by removing the leaves as close to the base as possible and eating the petiole. Beavers do not eat the blade and may leave piles of blades at their feeding sites. After floods, piles of wrack often contain hundreds of severed blades, indicating the extent of beaver herbivory. Under conditions in which large carnivores controlled beaver populations more effectively than presently, such damage may have been rare. Partial defoliation may reduce the fitness of juvenile and immature specimens by slowing the rate of new leaf production, as found for *Astrocaryum* by Mendoza et al. (1987). On the other hand, if beavers remove the oldest leaves from mature specimens, increases in leaf and fruit production may occur. We do not know the ages of plants damaged by beavers.

Herbivore damage to fruits occurs occasionally. On a number of clusters we examined, gnawing marks of incisors were clearly discernable and the seeds were absent. Manley (1967) and Shuey and Wonderlin (1977) found evidence of mammal damage to fruits. Such damage does not seem extensive enough at any sites we have visited to affect population size.

Two causes of mortality to mature palms have been noted during our study. Extremely high levels of flooding, resulting from lack of vegetative cover in upstream portions of the watershed, may wash out mature specimens. After the Winter and early Spring floods of 1996, we found a number of mature plants stranded in the middle of scour drainages at our site. All of these plants subsequently died. Under conditions of normal drainage protection, this type of mortality would be very rare.

The second cause of mortality to mature specimens is tree fall. When a large limb or the trunk of a fallen tree impacts the meristem of a plant or ramet, the individual dies. Although this type of mortality was rare from 1991-1994, in the fall of 1995 the many windfalls resulting from hurricane Opal caused the death of a number of mature needle palms. Such events are episodic and probably do little damage to healthy populations. Often, only one ramet of a clump is killed. The clonal growth habit thus lessens the mortality risk to the genet (De Steven 1989). Benefits may be derived from tree fall by the creation of light gaps which possibly supply seedling habitat at the edges.

Clearcutting eventually destroys needle palm populations. Most are destroyed by tree fall impact and physical disturbance during tree removal. At sites examined in the past two decades in Alabama, Florida and Mississippi in which clearcutting has removed the overstory, we have observed very few seedlings of needle palms, although a few mature specimens have produced fruit at the sites. Mature specimens, both in the wild and in cultivation, seem to survive in open sun. However, it is likely that seedlings cannot survive full sunlight. Thus reproduction may cease after clearcutting. Bjorkman (1981) and Chazdon (1986) found that seedlings of rain forest understory palms showed injury and growth inhibition under high intensity sunlight.

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It is possible that bottomlands, such as the one studied, are the major habitat of needle palm. Low rates of reproduction at mesic ravine sites may indicate that most populations in these habitats are dispersal sinks. How these isolated populations in mesic forests and hammocks originate is not known since needle palm diaspores are not known to be ornithochorous or endozoochorous, although both are possible.

In most respects, the population we studied is healthy and thriving, although slow degradation is occurring as a result of flooding intensified by upstream watershed modifications. We found no indication of "senescence" in the plants or the populations. Because new needle palm ramet meristems do not form from older apical meristems, the accumulation of somatic mutations would be unlikely to occur at a significant rate. Potential harvest of timber is a threat to the population since the site has no formal protection. Grazing is also a threat although does not seem likely in the near future. Digging of plants for horticultural and nursery use has not occurred at the site as far as is known.

ACKNOWLEDGEMENTS

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A COMPARISON OF FAUNAL COMMUNITIES IN ALGAL MATS
IN TWO COLD SPRINGS IN THE SOUTHEASTERN UNITED STATES¹

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ABSTRACT

The faunal communities and physical structure of 3 types of algal mats were compared. Samples were taken from *Hydrodictyon reticulatum* mats at Magnolia Springs, Jenkins County, Georgia and from *Spirogyra* and *Cladophora* mats at Roebuck Spring, Jefferson County, Alabama. Mat depth, algal density and light penetration were significantly different. Testate amoebae, rotifers, microcrustaceans, annelids, gastropods and insects were counted in dip net and/or core samples. Significant differences in the relative abundance of faunal groups were seen between springs and between algal mats of the same spring. Rotifers and coleopterans were most abundant in *Spirogyra* mats, but slime may have prevented significant colonization by testate amoebae and microcrustaceans. Snails were most abundant in the stiff *Cladophora* mats. Snails and surface hemipterans were less abundant at Magnolia Springs but testate amoebae, copepods and insect nymphs were abundant in its *Hydrodictyon* mats.

INTRODUCTION

Springs can be ideal places for ecological studies. Because of the relative constancy of water temperature, flow, and chemical composition, the effects of other factors on spring communities can be easily studied. Odum (1957) described springs as steady state ecosystems. Many studies of cold and thermal springs have emphasized dynamic processes rather than community structure (Odum 1957, Teal 1957, Tilly 1968, Wickstrom and Wiegert 1980, Wiegert and Fraleigh 1972). Few studies have attempted to quantitatively characterize the faunal communities of springs (Davidson and Wilding 1943). A number of recent studies, however, have emphasized the complexity of interactions among the faunal elements of spring communities (Blinn et al. 1993, Dehdashti 1987, Runck and Blinn 1994).

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Spring biota are biologically interesting for a number of reasons. Many springs support a diversity of unique biota adapted to specific temperatures and oxygen levels (Hubbs 1995). A few spring-adapted species exhibit deviations from the life cycle typical of their group (Nielsen 1950a). In some cases, species typical of both lotic and lentic fresh water habitats may be found in springs (Hynes 1970). Often, because of the relative lack of seasonality in springs, relicts or species well outside their normal ranges may be found (Nielsen 1950b). In areas where spring habitats are isolated from other such habitats, dispersal becomes an important factor in the biology of spring adapted forms such as the flightless water beetle, *Hydroporus ferrugineus* (Hynes 1970). Although the insect fauna of cold springs has been poorly studied, it is usually found to be much lower in density and diversity than in other aquatic habitats (Sloan 1956, Young 1955).

The diversity of algae in cold springs, although greater than that of hot springs, is less than in other aquatic habitats (Round 1981). Some have considered spring algal communities to exist at a perpetually immature stage of succession (Eddy 1925, Round 1981, Whitford 1956). The filamentous colonies which form algal mats are temporary and fluctuating in other habitats, but are relatively permanent in springs. Seasonal fluctuation is mediated only by a decrease in light availability and not by changes in temperature. The existence of algal mats as discrete entities has seldom been recognized (Hillebrand 1983, Round 1981). Dodds (1991), however, described the floating algal mats of a spring as spatially and temporally distinct subhabitats in which water chemistry and current may be altered from that of surrounding areas.

Algal mats are known to form matrices for colonization by other organisms (Dodds 1991, Wiegert and Mitchell 1973). In this study, the relatively constant state of spring algal mats presented an opportunity to compare the faunal communities which have colonized mats of different algal species and physical structure. A comparison was made of the faunal communities in mats of different springs and of different mats within the same spring. An attempt was made to correlate the differences in faunal community structure to the physical characteristics of the algal mats involved.

DESCRIPTION OF SITES

Magnolia Springs State Park, Jenkins County, Georgia is located in the lime-sink region of the Coastal Plain. The spring produces 6,250 gallons of water per minute, creating a broad pool, 4 to 5 meters deep, before the spring run. The water temperature near the boil was measured at 19C. Unfortunately, no published information is available on the water chemistry of this spring, although officials at the park (pers. comm.) stated that the water is relatively hard. Other springs in the area have been analyzed as having approximately 126 ppm calcium carbonate (McCallie 1913).

At the time of this study, dense floating mats of the alga, *Hydrodictyon reticulatum*, extended from the edges of the pool toward the center for a distance of 1 to

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2 m. Small amounts of *Lemna* sp. and *Myriophyllum* sp. were mixed in the algae. A tangle of dead grasses occurred beneath parts of the mat. A sparsely wooded area extends to near the edge of the pool at one side. All mats found suitable for use in this study were on the unshaded side of the spring. The algal mats were relatively stable in size and position for several months previous to the study. *Hydrodictyon* mats are deep and spongy. The cells are arranged hexagonally, creating a tangled network which contains many large air pockets.

The second spring site used in this study is located in Roebuck, Jefferson County, Alabama and will be referred to as Roebuck Spring. It is located in the Ridge and Valley Province. Many other small springs are present within a few miles of this site. The spring produces 500 gallons of water per minute. The relatively small pool, approximately 2 meters deep, is partially surrounded by a concrete wall with a spillway opening into the spring run. The temperature near the boil was measured at 17 C. An analysis of the water chemistry (Knight 1976) revealed 197.6 ppm calcium carbonate.

At the time of the study, and for several months before, dense floating algal mats extended from the bank and from a concrete wall on both sides of the water flow. The mats were up to 3 m wide and consisted of patches of *Spirogyra* sp. interspersed within patches of *Cladophora* sp. Although some mixing of algae was found, most were pure mats of one species immediately adjacent to pure mats of the other. The algal mats were free from any association with the bottom. Very few other plants were found in the pool. The nearby wooded area did not extend to the edge of the pool and no portions of the algal mats were shaded. However, a considerable amount of leaf material had blown into the pool at the time of this study. *Spirogyra* mats are thin, flexible and foamy, containing many small air bubbles among the slime surrounding the algal cells. In comparison, *Cladophora* mats are thick and inflexible, made up of coarse and wiry algal strands with no slime.

MATERIALS AND METHODS

Information and samples were gathered from *Hydrodictyon* mats at Magnolia Springs on October 22, 1983 and from *Spirogyra* and *Cladophora* mats at Roebuck Spring on November 6, 1983. Water temperature was measured at both springs. Measurements of mat depth were made at 10 arbitrarily chosen spots within each type of mat. A Li-Cor LI-188B underwater light meter was used to measure light penetration in each type of mat. Readings, in microeinsteins and integrated over 10 seconds, were taken both with sensor above the mats and with sensor below the mats at depths equal to the average depth of each type mat. A percentage of the light penetrating the mat was calculated from the two readings.

Five to 7 core samples were taken in each type mat using a 10 cm cylinder. A tightly fitting, plastic lid was held at the bottom of the mat and the cylinder was lowered on to the lid and snapped closed. Algal strands were cut away from the edges of the cylinder and the contents were poured into jars with formalin to create a 10% fixative solution.

In the laboratory, core samples were stirred and shaken in the formalin solution in order to loosen organisms from the algal strands. The liquid portions of samples were then run through a filter series of 2 mm and 64 micron mesh, and washed with 3 times the volume of water. The portion of each sample collected in the large mesh was placed in ethanol and examined with a dissecting microscope. Operational taxa which were counted in the mat portion of core samples included: snails, oligochaetes, planarians, amphipods, dipteran larvae, hemipterans, coleopterans (larvae and adults), and odonate and ephemeropteran nymphs. Animal counts were converted to numbers per liter.

The portion of each sample collected in the fine mesh was washed into 20 ml of 95% ethanol. From each of these samples, 3 Sedgewick-Rafter cells were filled. Ten 20 mm transects were counted in each cell using a Whipple disc in a compound microscope at 43X magnification. Operational taxa counted in Sedgewick-Rafter cells included: testate amoebae, loricate rotifers, cladocerans, ostracods, copepods (adults and nauplii), oligochaetes, amphipods and dipteran larvae. (Testate amoebae were the only protozoans counted in this study since they are easily recognizable after fixation in formalin.) In cases where animals were counted in both portions of the filtered sample, numbers per liter were added to get a final value.

Any additional animals remaining in mat core samples were removed by hand, counted and added to the numbers from the filtered samples. Each algal mat core sample, with animals removed, was oven dried and weighed. The final weight was divided by the original volume of each sample to calculate a density value of g per liter.

Ten standardized dip net samples were also taken in each mat in order to capture surface hemipterans and other rapidly moving insects which would have been missed in the core samples. Each dip was made to approximately the depth of the mat and for a length of approximately the width of the net (32 cm). Dip net samples were later examined for animals. Although less quantitatively consistent than the core samples, dip net samples were converted by a factor of 1/13 to approximate the same surface area sampled by the core. Numbers of animals per liter were calculated by using the average volume of core samples. They were also considered as numbers per sample. Animals counted in dip net samples included coleopterans, hemipterans, odonates and ephemeropterans.

Identifications of animals were made to the lowest taxonomic category as was easily possible, using appropriate manuals (Brigham et al. 1982, Edmondson 1959). This allowed species identification of many of the insects but not of most other taxa. ANOVA was used to discern differences in physical parameters and animal numbers between mat types and springs. Wherever possible, core sample values were used in statistical analyses rather than dip net sample values.

The extent to which mat types had groups or species in common was quantified by the Sorenson coefficient of similarity $\{C=2j/(a+b)$ where j =the number of species in common, and a and b are the total numbers of species in each habitat) (Sorenson

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1948). This method considers only the presence or absence of species and gives as much importance to the rare species as to the abundant species. These calculations are somewhat artificial because in many cases higher level taxonomic groups were used as species.

RESULTS

Measured parameters that describe the physical qualities of each type mat included mat depth, light penetration and density. The average values are shown in Table 1. *Hydrodictyon* mats at Magnolia Springs were significantly less dense than the *Cladophora* mats at Roebuck Spring ($P < .05$). *Spirogyra* mats at Roebuck Spring were of significantly less depth and allowed significantly less light penetration than did the other 2 types ($P < .05$). (Light penetration measurements may have been altered by the presence of leaves in the mat.)

Table 1. Physical parameters compared among 3 types of algal mat at 2 spring sites in Alabama and Georgia. Values with different letters following (a,b) are significantly different ($P < .05$). (n=7).

algae type	mat depth (cm)	light penetr. (%)	mat density (g/l)	spring site	Temp. (C)
<i>Hydrodictyon</i>	3.9 a	5.3 a	1.82 a	Magnolia Spr.	19
<i>Spirogyra</i>	1.5 b	1.9 b	2.10 ab	Roebuck Spr.	17
<i>Cladophora</i>	2.8 a	2.3 a	2.59 b	Roebuck Spr.	17

Many of the organisms encountered in this study are very common and are typical of a variety of aquatic habitats, e.g. *Erythemis simplicicollis* (Odonata: Libellulidae). Others are typical of the filamentous algal habitat, e.g. *Peltodytes* sp. (Coleoptera: Haliplidae). A list of the organisms found in each type mat is included in Table 2. The species or groups that were common to all 3 mats include: testate amoebae, loricate rotifers, cladocerans (although the species differed between springs), copepods, ostracods, the snail, *Physa* sp., the oligochaete, *Stylaria* sp., the surface hemipteran, *Microvelia* sp. (Veliidae), and the dipteran larvae, *Odontomyia* sp. (Stratiomyiidae) and Chironomidae.

The *Hydrodictyon* mats in Magnolia Springs harbored more unique, or unshared organisms than did the 2 mat types in Roebuck Spring. This was expected, because the 2 springs are widely separated geographically. Coefficients of similarity among the fauna

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HSC	testate amoebae - <u>Arcella</u>
H C	<u>Centropixis</u>
H C	<u>Diffflugia</u>
HS	Planaria
C	<u>Dugesia tigrina</u>
HSC	loricate rotifers
SC	Gastropoda - <u>Elimia</u>
H	<u>Gyraulus</u>
HSC	<u>Physa</u>
H	<u>Promonetus</u>
HSC	Oligochaeta - <u>Stylaria</u>
C	Tubificidae
HSC	Cladocera
HSC	Copepoda
C	Ostracoda
HSC	Amphipoda
C	Isopoda - <u>Lirceus</u>
H	Decapoda - <u>Palaemonetes paludosus</u>
	Insecta
C	Collembola - Entomobryidae
H	Sminthuridae
H	Ephemeroptera - <u>Cleon</u> (Baetidae)
H	Odonata - <u>Basiaeschna janata</u> (Aeshnidae)
HS	<u>Erythemis simplicicollis</u> (Libellulidae)
H	<u>Sympetrum</u>
HS	<u>Argia</u> (Coenagrionidae)
S	Hemiptera - <u>Belostoma lutarium</u> (Belostomatidae)
SC	<u>Merragata hebroides</u> (Hebridae)
HSC	<u>Microvelia</u> (Microveliidae)
H	<u>Mesovelia mulsanti</u> (Mesoveliidae)
H	<u>Trichorixa sexcincta</u> (Corixidae)
H	<u>Pelocoris femoratus</u> (Naucoridae)
H	<u>Neogerris hesione</u> (Gerridae)
C	Trichoptera
S	Coleoptera - <u>Laccophilus proximus</u> (Dytiscidae)
H	<u>L. maculosus</u>
S	<u>Hydroporus rufilabris</u>
C	<u>H. ruficeps</u>
H	<u>Hydrocanthus oblongus</u> (Noteridae)
SC	<u>Helochaeres macullicollis</u> (Hydrophilidae)
H C	<u>Laccobius agilis</u>
S	<u>Helobata striata</u>
S	<u>Hydrobius fuscipes</u>
C	<u>Paracymus dispersus</u>
H	<u>Berosus</u>
HS	<u>Peltodytes</u> (Haliplidae)
H	<u>Haliplus punctatus</u>
HSC	Diptera - <u>Odontomyia Stratiomyiidae</u>
SC	<u>Stratiomys</u>
SC	<u>Tipula</u> (Tipulidae)
HSC	Chironomidae larvae
C	<u>Telmatoscopus superbus</u> (Psychodidae)
H	Culicidae

Table 2. All taxa counted in dip net and core samples in 3 types of algal mat. H= *Hydrodictyon* mats in Magnolia Springs, Georgia; S= *Spirogyra* mats and C= *Cladophora* mats in Roebuck Spring, Alabama.

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inhabiting the 3 mat types are as follows: when comparing *Hydrodictyon* mats to *Spirogyra* mats, $C=.32$; *Hydrodictyon* to *Cladophora*, $C=.23$; and *Spirogyra* to *Cladophora*, $C=.59$. The two mat types within the same spring are most similar.

Considering only the number of shared species, the 2 mat types in Roebuck Spring appear to be more similar to each other than to the mat type at Magnolia Springs. If we consider the relative abundance of taxonomic groups, however, some striking differences appear between the 2 mat types at the same spring (Fig. 1). Each group is represented as a percent of total numbers in the microfauna, which include testate amoebae, rotifers, cladocerans, copepods and ostracods. The most abundant group in the microfauna in the *Spirogyra* mats was the rotifers, with testate amoebae and cladocerans nearly absent, and ostracods completely absent. In *Cladophora* mats in the same spring, however, all 5 groups of the microfauna were relatively evenly represented. In *Hydrodictyon* mats the number of testate amoebae far outweighed the numbers of specimens in other microfaunal groups.

There were highly significant ($P < .05$ and $P < .01$) differences among the numbers of insects and other macroinvertebrates collected from each of the 3 algal mat types (Table 3). Most pronounced in this comparison is the fact that several groups are lacking or are significantly less abundant in the *Spirogyra* mats. The rapidly moving, large or sparsely distributed insects that were captured only in dip net samples were compared separately (Table 4) because relatively fewer individuals were encountered in these groups. Ephemeropterans were collected only at Magnolia Springs. Relatively few odonates were collected at Roebuck Springs. (Only a few small odonate nymphs showed up in core samples of the *Cladophora* mats.) Surface hemipterans were most abundant at Magnolia Springs, and coleopterans (especially *Peltodytes* sp. (Haliplidae) larvae) were most abundant in the *Spirogyra* mats of Roebuck Spring.

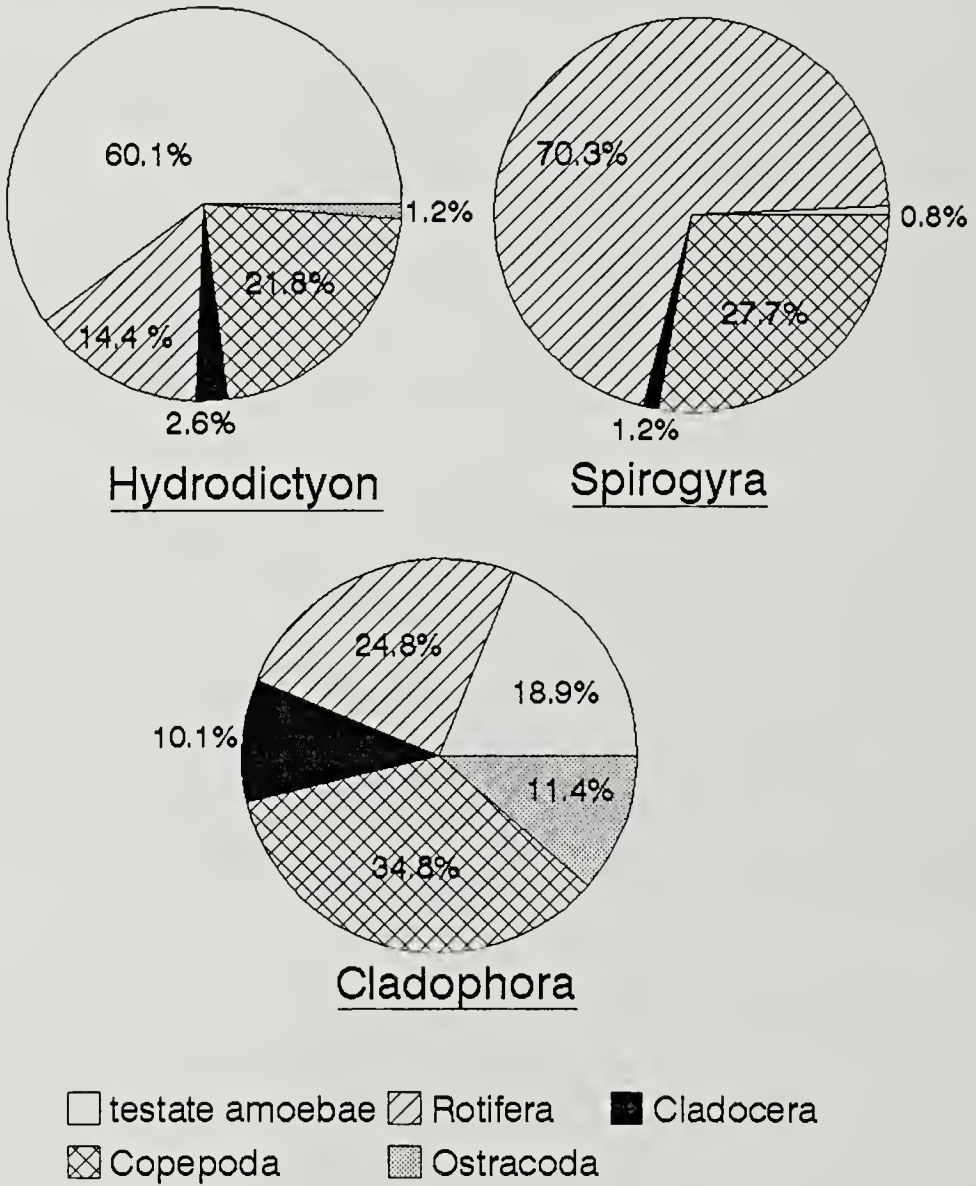


Fig. 1. The relative abundance of microfauna groups in the faunal communities of 3 types of algal mat, sampled in Magnolia Springs, Georgia (*Hydrodictyon*) and Roebuck Spring, Alabama (*Spirogyra* and *Cladophora*). Values are the average percent of total numbers of microfauna counted in core samples.

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Table 3. Average sample counts of micro- and macrofauna in 3 types of algal mat, sampled in Magnolia Springs, Georgia and Roebuck Spring, Alabama. All figures represent numbers per liter. (*P<.05, **P<.01; a, b, and c indicate significantly different means, n=5.)

	<i>Hydrodictyon</i>	<i>Spirogyra</i>	<i>Cladophora</i>	
testate amoebae	33,750 a	36 b	1,924 c	**
Rotifera	8,079 a	8,257 a	2,521 b	**
Cladocera	1,476 a	145 b	1,029 a	*
Copepoda	12,228 a	3,243 b	3,533 b	**
Ostracoda	660 a	0 b	1,156 c	**
Amphipoda	151 a	55 a	123 a	NS
Gastropoda	11 a	22 a	168 b	**
Oligochaeta	550 a	76 a	301 a	NS
Planaria	12 a	2 a	2 a	NS
Ephemeroptera	5 a	0 a	2 a	NS
Odonata	49 a	0 b	2 c	**
surface Hemiptera	15 a	39 a	2 b	*
aquatic Hemiptera	14 a	0 b	0 b	**

Table 4. Average sample counts of insects captured by dip net in 3 types of algal mat in Magnolia Springs, Georgia and Roebuck Spring, Alabama. (*P<.05, **P<.01; a,b,and c indicate significantly different means, n=10.)

	<u>Hydrodictyon</u>	<u>Spirogyra</u>	<u>Cladophora</u>	
Ephemeroptera	1 a	0 b	0 b	**
Odonata	5 a	1 b	0 c	**
surface Hemiptera	3 a	47 b	40 b	*
aquatic Hemiptera	14 a	10 a	0 b	**
Coleoptera	1 a	4 b	1 a	**
Diptera	1 a	14 a	6 a	NS

DISCUSSION

The data indicate that significant differences occur in the faunal communities of spring algal mats of different types. In certain faunal groups the difference is greater between mat types within one spring than between different geographic locations. Differences in mat depth, density and light penetration may partially explain the differences in the faunal communities. Other physical characteristics, though less easily measured, may also play a part in determining the makeup of the inhabiting communities.

The mats differ in gross physiognomy and speculations can be made as to how these factors have resulted in the faunal differences observed. The slime that surrounds cells of *Spirogyra* may prohibit locomotion of some organisms (e.g. testate amoebae, cladocerans, and ostracods). The stiffness and compact nature of *Cladophora* mats is sufficient to support a large number of snails compared to the flexible *Spirogyra* mats but may prevent penetration by some species (e.g. *Peltodytes* sp.). *Peltodytes* larvae, which were found abundantly in *Spirogyra* mats, may also be less efficient at locomoting within the tangled mats of *Hydrodictyon*, where only adults were found.

For other taxa, geographical limitations seem to explain the differences between mats. Lay and Ward (1987) found dramatically different species compositions when comparing stream algal communities of streams in different physiographic provinces of Alabama. The paucity of snails in the *Hydrodictyon* mats of Magnolia Springs may be explained by the fact that the range of the *Elimia* species, specimens of which were very abundant at Roebuck Spring, does not extend into the Coastal Plain.

In some cases, the abundance of certain groups may have resulted from the absence of other groups. For example, rotifers were proportionately more abundant in *Spirogyra* mats where other portions of the microfauna were absent.

Many factors not accounted for in this study may be important in determining the structure of faunal communities within spring algal mats. Single celled algae and bacteria colonizing the mats may be important parts of the food chain but were not counted in this study. Vertebrate predators were not considered. Successional variation, although slight in springs, may have accounted for some of the observed differences. Other studies of similar habitat (Davidson and Wilding 1943) list numbers per sample of unspecified volumes and cannot be easily compared to this study.

Regardless of the explanation, it is clear that the species of algae in floating algal mats determines, in part, the taxonomic makeup of the inhabiting faunal community. Sampling the faunal communities of similar algal mats in other areas may reveal that the community differences seen here are present elsewhere.

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REVIEW OF PHARMACOLOGIC TREATMENT OF HYPERTENTION¹

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ABSTRACT

Pharmacologic management of hypertension has been proven to significantly reduce mortality and morbidity related to coronary artery disease in selected drug groups. There is a significant increase in cardiovascular disease including coronary heart disease, stroke, and renal disease when coupled with higher elevations of both systolic and diastolic blood pressures. This article reviews diagnosing, pharmacology, interventions, and treatment of hypertensive individuals.

REVIEW OF PHARMACOLOGIC TREATMENT OF HYPERTENSION

Approximately 50 million people in the United States have elevated blood pressure, with the greatest preponderance found in the elderly population. Blood pressure increases with age affecting 60% of Americans older than 65 years of age (1, 5). Hypertension is defined as systolic pressure 140 mmHg or greater and diastolic blood pressure 90 mmHg or greater. The stages of hypertension as classified by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure are presented in Chart 1 (4).

There are two types of hypertension, primary or essential hypertension for which no identifiable cause is found; and secondary hypertension for which an identifiable cause may be found. The most common underlying cause of secondary hypertension is generally cardiovascular disease. Cardiovascular disease including coronary heart disease, stroke and renal disease show significant increase in incidence when coupled with higher levels of both systolic and diastolic blood pressure readings (1). Healthy People 2000: National Health Promotion and Disease Prevention Objectives published in 1990 by the Department of Health and Human Services target reducing heart disease and stroke by the year 2000 through several goals. These goals include reducing deaths from coronary heart disease to no more than 100 per 100,000 people, reducing deaths from stroke to no more than 20 per 100,000 people, and controlling blood pressure in at least 50 per cent of the people with hypertension (2).

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Chart 1
Classification of Blood Pressure
for Adults Age 18 Years and Older

Category	Systolic*	Diastolic*
Normal	< 130	< 85
High normal	130-139	85-89
Hypertension		
Stage 1 (mild)	140-159	90-99
Stage 2 (moderate)	160-179	100-109
Stage 3 (severe)	180-209	110-119
Stage 4 (very severe)	≥ 210	≥ 210

* (mm Hg)

Source: Fifth report of the joint national committee on detection, evaluation, and treatment of high blood pressure, NIH, National Heart, Lung, and Blood Institute, 1993, NIH Pub. # 93-1088.

Elevated blood pressure is only one of the risk factors which predisposes individuals to cardiovascular disease. Other risk factors include family history, age, gender (more common in males), race (more common in the black population), obesity, alcohol, excess sodium in the diet, stress, and lack of physical activity (16). All of these play an important part in designing individual treatment protocols for the person with hypertension. Drug therapy cannot be used in abstensia without also including lifestyle modifications related to nutrition, exercise, social habits, and stress reduction (9, 15). However, the purview of this article is limited to the review of current pharmacologic therapies in the adult population.

DIAGNOSING HYPERTENSION

Prior to the initiation of drug therapy for hypertension, an individual must be thoroughly evaluated. The diagnosis for hypertension should ideally be made based on several measurements of hypertension on different occasions. The possibility of "white coat" hypertension should be considered, especially in those individuals prone to anxiety when visiting a health care professional. Ambulatory 24 hour blood pressure monitoring can be used if blood pressure readings are questionable. The individual should not have a full bladder or recently partaken of caffeine or tobacco. The person should be at rest for a minimum of five minutes before blood pressure measurements are obtained. At least

two blood pressures readings should be obtained separated by at least two minutes with the person either supine or seated after standing for at least two minutes. Verification should be made in the opposite arm (4, 5, 6). Blood pressures are grouped into two populations, pediatric and adult. The division point between these groups occurs at eighteen years of age. The following chart depicts the follow-up recommendations for blood pressure readings in adults over eighteen years of age (4).

Chart 2

RECOMMENDATIONS FOR FOLLOW-UP BASED ON
INITIAL SET OF BLOOD PRESSURE MEASUREMENTS
FOR ADULTS AGE 18 AND OLDER

Initial Screening
Blood Pressure
(mm Hg)

Systolic	Diastolic	Follow-up Recommended
< 130	85	Recheck in 2 years
130-139	85-89	Recheck in 1 year
140-159	90-99	Confirm within 2 months
160-179	100-109	Evaluate/refer to source of care within 1 month
180-209	110-119	Evaluate/refer to source of care within 1 week
≥ 210	≥ 210	Evaluate/refer to source of care immediately

Source: Fifth report of the joint national committee on detection, evaluation, and treatment of high blood pressure, NIH, National Heart, Lung, and Blood Institute, 1993, NIH Pub. # 93-1088.

When selecting a drug agent consideration should be given to effectiveness, side effects and cost constraints. Drug monotherapy is the guiding principle for treating hypertension today. It is a logical process to choose a single agent at the lowest dose and determine the efficacy prior to increasing the dose or adding other medications (10, 11). However, two drug combinations at lower doses can be used effectively while minimizing unwanted side effects (7). The following groups of medicines have been employed in the management of hypertension: diuretics, beta adrenergic receptor blockers (beta blockers), calcium channel blockers, angiotensin converting enzyme inhibitors (ACE inhibitors), alpha-1 adrenergic receptor antagonists, central alpha-agonists, angiotensin II receptor blockers and other agents (1, 7, 12).

When initiating individual therapy the following variables should be considered: age, race, lipid profiles, and concurrent disease processes. The younger age group, less than 60, responds better to beta blockers than do those over the age of 60 which respond more effectively to diuretics, ACE inhibitors, or calcium blockers. Generally lower doses are initially used with the elderly. The black population generally responds better to diuretics or calcium blockers than to beta blockers or ACE inhibitors. However, beta blockers and ACE inhibitors have both been used in combination therapy. Beta blockers and ACE inhibitors appear to work well in the white population. Lipid profiles are important as diuretics may increase serum triglyceride and cholesterol levels and lower HDL cholesterol levels. Triglyceride levels may increase with the use of beta blockers. In addition, drug therapy choices must be made with underlying diseases processes in mind. Chart 3 contains some examples of disease processes which can influence drug choices (15,16).

PHARMACOLOGIC INTERVENTION

The objective of pharmacologic intervention is to reduce elevated blood pressure levels to less than 140/90 with as few side effects as possible, especially in individuals less than 60 years of age. However, in the elderly (over 60 years of age) an acceptable blood pressure approximating 160/90 may be a satisfactory end point if further reduction cannot be made without undesirable side effects. A phenomenon known as the "J" curve can occur when the diastolic blood pressure is lowered to less than 80-85 mm Hg. This entails an increase in the risk of myocardial infarction and sudden death, but this phenomenon has not been scientifically supported to this date. Prevention of target organ disease in heart, brain, eyes, kidneys and peripheral vessels is also essential (8). The ensuing discussion addresses the current drug modalities.

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Chart 3
DETERMINING DRUG THERAPY BASED
ON COEXISTING DISEASE PROCESSES

Coexisting Disease	Preferred Drug	Not Preferred
Angina Pectoris	Beta Blocker Calcium Blocker	Some Vasodilators
Asthma/COAD	Diuretic Calcium Blocker ACE Inhibitor (without cough)	Beta Blocker (unless cardioselective)
Bradycardia Conduction Defects		Beta Blocker
Congestive Heart Failure	Diuretic ACE Inhibitor	Beta Blocker
Depression Confusion	Diuretic Calcium Blocker Alpha Blocker ACE Inhibitor	Beta Blocker Alpha ₂ Agonist
Diabetes	Calcium Blocker ACE Inhibitor	Beta Blocker Diuretic
Hyperlipidemia	Alpha Blocker Calcium Blocker ACE Inhibitor Alpha ₂ Agonist	Diuretic Beta Blocker
Renal Failure	Diuretic Beta Blocker Calcium Blocker *ACE Inhibitor	Potassium-sparing Diuretic
Peripheral Vascular Disease	Calcium Blocker	Beta Blocker
*Not used with RAS or volume depletion		

Sources: Sadowski, A. V., & Redeker, N. S. (1996). The hypertensive elder: A review for the primary care provider. *Nurse Practitioner*, 21(5), 99-118.

Wiser, T. H., & Young, L. Y. (1988). Essential hypertension. In L. Y. Young & M. A. Koda-Kimble (Eds.), *Applied therapeutics: The clinical use of drugs* (4th ed.) (pp. 7.1-8.0). Vancouver, WA: Applied Therapeutics.

Diuretics

Diuretics produce hypotensive effects by arteriolar vasodilatation. They decrease plasma volume by increasing the elimination of excess sodium and water through the suppression of tubular reabsorption of sodium. Diuretics have been shown to significantly reduce mortality and morbidity related to coronary artery disease (4). Adverse effects for thiazide diuretics may include hypokalemia, hyperuricemia, hypercalcemia, increased glucose, hyponatremia, hypomagnesemia, increased lipid levels, rash and impotence. Loop diuretics have similar side effect but may produce excessive loss of bodily fluids and electrolyte disturbances. Potassium sparing diuretics is cautioned with concomitant use with ACE inhibitors. Drug interactions can occur with NSAIDS, hypoglycemics, oral anticoagulants (6, 8, 9, 12, 15)

ACE Inhibitors

ACE inhibitors block angiotensin converting enzyme and prevent the formation of angiotensin II, which is a potent vasoconstrictor. This results in a reduction of peripheral resistance and lower arterial blood pressure. ACE inhibitors suppress aldosterone secretion, thus decreasing sodium retention and also increase levels of bradykinin for vasodilation. The most common side effect is a chronic dry cough. Other side effects include hypotension, dizziness, renal dysfunction, hyperkalemia, angioedema, rash and taste disturbances. The uses of these drugs are precluded in bilateral renal artery stenosis, but have been used in unilateral renal artery stenosis. Drug interactions can occur with potassium sparing diuretics and potassium supplements (6, 8, 9, 12, 13, 15).

Beta Blockers

Beta blockers block the agonist effects of adrenergic neurotransmitter. There are two classes of beta blockers. Beta blockers inhibit receptors in the heart, while Beta 2 blockers inhibit receptors in the bronchi, periphery, kidney, liver and pancreas. Intrinsic sinoatrial or partial agonist activity can cause a decreased stimulation of adrenergic receptors. Side effects may include bradycardia, dizziness, bronchospasm, reduced peripheral circulation, impaired sexual function, insomnia, Raynaud's exacerbation, mental depression, weakness and manifest a withdrawal effect. Drug interactions can occur with anesthetic agents, antidiabetic drugs and sympathomimetics (6, 8, 9, 12, 15).

Calcium Blockers

Calcium channel blockers are thought to act by inhibiting calcium entry through select voltage-sensitive channels. Through reducing calcium in the cardiac and smooth vascular musculature, these drugs dilate coronary arteries, peripheral arteries and arterioles. The effects of these drugs can be slowing of the heart rate, decreased

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myocardial contractility and decreased atrioventricular conduction which can lead to cardiac dysfunction, such as myocardial infarction. The serum calcium levels are generally unchanged. Adverse effects can include constipation, flushing, edema, angina, tachycardia, bradycardia, gingival hyperplasia, arthritis and occasionally transient blindness. The concern over the use of calcium blockers was attributable to the increase in myocardial infarctions in a highly compromised sample population. This is a potential adverse effect for certain patients, one of which cannot be predicted. They can be used with proper monitoring of patients, as can all hypertensive medications. Drug interactions can include beta-adrenergic blockers, sympathomimetics and antiarrhythmias (6, 8, 9, 12, 13, 15).

Alpha-1 Blockers

Alpha 1 blockers are a peripheral post-synaptic alpha-1 adrenergic receptor antagonists that produce vasodilation and reduce peripheral resistance, but usually do not affect cardiac output. Chronic dosing is usually not accompanied by reflex tachycardia and has little effect on renal blood flow and glomerular filtration. Adverse effects can include first dose orthostasis, angina, peripheral edema, urinary incontinence, palpitations and dizziness which recur with dosage increases and can be exacerbated after exercise. Drug interactions can include other antihypertensives, NSAIDS, estrogens and sympathomimetics (6, 8, 9, 12, 14, 15).

Angiotensin II Blockers

Angiotensin II blockers are highly selective for the AT-1 receptor. This receptor antagonism blocks the vasoconstrictor and aldosterone-secreting effects of angiotensin II. Increases are seen in plasma renin and angiotensin II. There is a possibility that antiplatelet and uricosuric effects may be seen. However, therapeutic relevance is not yet known. Side effects include headache, back pain, fatigue, cough (however much less than with ACE inhibitors), upper respiratory infection, leg pain, sinus problems and may have teratogenic effects. Drug interactions may include NSAIDS, diuretics, potassium supplements and salt substitutes (6, 8, 9, 12, 15).

Central Sympatholytics

Central sympatholytic agents lower blood pressure through stimulating alpha-adrenergic receptors in the central nervous system and consequently decreasing efferent peripheral sympathetic flow. Occasionally these agents are used as a first line therapy, but usually are reserved for refractory pressures. Side effects include sedation, postural hypotension, fatigue, dry mouth and impotence. Rebound hypertension can occur on withdrawal from the drugs. Drug interactions may include tricyclic antidepressants, alcohol, beta-adrenergic blockers and CNS depressants (6, 8, 9, 12, 15).

Peripheral Adrenergic Antagonists

These agents are currently used on an infrequent basis primarily due to unwanted side effects. Reserpine interferes with the binding of serotonin at receptor sites by depleting dopamine. It also depletes norepinephrine and serotonin in the heart and other systems. Side effects include mental depression, sedation, nasal stuffiness, and sleep disturbances. Guanethidine inhibits catecholamine release from peripheral neurons but often causes orthostatic hypotension, diarrhea and fluid retention. These drugs are usually utilized in refractory cases. Drug interactions may include antiarrhythmic, MAO inhibitors, other antihypertensive agents, alcohol and sympathomimetics (6, 8, 9, 12, 15).

Direct Vasodilator

These drugs relax smooth vascular musculature and produce peripheral vasodilation. Side effects include tachycardia, increased myocardial contractility, headaches, palpitations and fluid retention. To counteract these adverse effects they are generally given with diuretics and beta blockers and are reserved for the most refractory cases. Drug interactions may include MAO inhibitors, other antihypertensive agents and antiarrhythmic (6, 8, 9, 12, 15). Reference CHART 4 for pharmacologic management.

The benefits of drug therapy for the control of hypertension are enormous as evidenced by longer life spans and the increased quality of life(6). The decision to use one drug classification over another is weighed by several factors as previously described. In addition, the initial stepped approach to begin drug therapy with diuretics and beta blockers has been losing favor with health care professionals who initiate therapy with other drug classes depending on the individual patient. A thorough listing of adverse effects and existing medical conditions for individualizing drug regimens is presented in charts 3 and 4. Therefore, the health care provider must undertake an extensive detailed history and physical in order to determine the most appropriate and beneficial hypertension program for each patient.

NURSING MEASURES AND PATIENT EDUCATION

Adherence to the regime for the maintenance of normotensive blood pressures is one of the most difficult problems for the health care provider to manage. Eliciting cooperation from individuals through an intense process of education is a must. Initially, the patient has to accept that their hypertensive condition will more than likely be a permanent one, even though a few individual patients have had their blood pressure medications stopped. Each patient harbors the hope of being able to stop taking their blood pressure medications. This hope of stopping the medications must be honestly analyzed according to each patient's condition in order not to raise false hope. The patient's concerns and fears need to be addressed as thoroughly as possible in the first discussion regarding their new diagnosis. Unfortunately, most patients are so upset by their diagnosis that very little learning takes place. Generally, on subsequent visits the patient becomes more receptive to additional information(1.4.8).

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Each patient receives information regarding their medication regime along with a thorough explanation discussing expected mechanisms of action and potential side effects. Medications are chosen depending on the patient's general medical condition, race, age, economic status and quality of life. Medication therapies vary widely among practitioners depending on personal experience and practice patterns. Therefore, each patient has an individualized plan for the management of their hypertension. Unfortunately, a cookbook approach is not possible and requires explanation as to why one person in a household may get a different medication than another(1.4.8).

Providing reinforcement and social support strengthens compliance with drug therapy. Feedback is important to the patient particularly when their blood pressure is under control and they have been doing a good job. Likewise, constructive criticism is appropriate when regimes are not being followed. Simplification of some therapies is essential for compliance. One pill a day versus multiple dosages ensures a more compliant patient. Self monitoring with their own blood pressure cuff and the keeping of a blood pressure diary is most beneficial for medication adjustments. The patient can also be encouraged to include in their diary any side effects and what they were doing when they occurred. Encouraging other family members in supporting the patient in their eating and exercise programs and offering positive feedback on their progress increases patient compliance. Most of all, before the patient leaves the office an appointment for the next visit should be made. When necessary more frequent appointments for nonadherent patients may be required(1.4.8). Health care providers have a responsibility to ensure that prudent and acceptable care has been rendered to patients in their care. Maintenance of a therapeutic regime for the hypertensive patient is a group effort between health care providers patients and families.

CONCLUSION

Patient follow-up and evaluation are essential for hypertensive management. Stable patients should be evaluated quarterly based on therapy and compliance. A thorough review and examination should be performed annually, in addition to the less comprehensive visits. These examinations are necessary to provide a baseline for therapeutic management. Routine monitoring of lab values such as lipids, sodium, potassium, uric acid and liver enzymes also contribute to overall systemic baselines. After a year of stable blood pressure control, the health care provider may choose to slowly lower the medication doses or even discontinue the medications. When discontinuing or decreasing dosages of blood pressure medication, the health care provider should gradually titrate the dosage downward while carefully monitoring resultant pressures. It is important to maintain the patient in a normalized blood pressure range of acceptance according to medical guidelines. Patients can assume to have a good prognosis with the successful control of hypertension (1, 8).

Additional areas of interest would be to study other racial and ethnic groups besides the white and black populations. More women should be included in the studies,

as well as, native Americans, Hispanics and Asian groups. Different cultures and races respond to medications differently as noted with the white and black populations. Other areas of study could include the transplantation of other cultures into the lifestyles of the United States and the possible relationship of hypertensive incidence when compared to their former countries. One area of interest is the European women who married soldiers and returned to the United States after World War II. Based upon personal observations in a private practice, a significant number of these individuals have hypertension with or without resultant cardiovascular complications when compared to the resident population. This could prove to be an interesting area of research, in addition to the other previously mentioned racial and ethnic groups.

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Chart 4
PHARMACOLOGIC MANAGEMENT

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
Thiazide Diuretics hydrochlorothiazide chlorthalidone (Never start with a combined product including thiazide and another drug)	Select agent on cost 12.5 mg daily (Some clinicians use a 6.25 but impractical)	Increase by 6.25-12.5 every 4 weeks. Rarely need > 25 mg/day. Maximum dose 50 mg/day as ↑ doses give no more hypotensive effect, but ↑ adverse effect.	↓K ⁺ , ↓Mg ²⁺ , ↑Ca ²⁺ , ↓Na ⁺ , ↑uric acid, ↑glucose, ↑LDL cholesterol, ↑triglycerides, rash, impotence	<u>Monitor Thiazide</u> <u>Toxicity:</u> Check potassium after 2 weeks and 4 weeks If stable, check if dosage or disease state change If < 3.5 meq/L (or < 4.0 meq/L on digoxin), dietary supplement and salt restriction. If ineffective, add 2.5 mg amiloride or triamterene 37.5-50 mg

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
<u>Loop Diuretics</u> furosemide	20 mg bid	40-320 mg in 2 or 3 doses	Same as thiazides. ↑ diuresis ↑ electrolyte imbalance ↑ Ca excretion	<u>Monitor:</u> Furosemide: Short duration of action a disadvantage; should be reserved for patient with renal insufficiency or fluid retention. Poor antihypertensive.
<u>Potassium-Sparing Diuretic</u> hydrochlorothiazide/-spironolactone	1 tab once daily	1 or 2 tabs once daily	Same as thiazides ↑ K, instead of ↓ K, headache	<u>Monitor:</u> Use should be limited to patients with demonstrable need for potassium-sparing agent. Caution in patients with renal failure or those taking ACE inhibitors;

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DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
ACE Inhibitors				
captopril	6.25 mg bid	12.5 mg daily q 4 weeks to max of 150 mg/d	Cough, hypotension, dizziness, renal dysfunction,	<u>Monitor BP Responses:</u> If DP > 115 mmHg, recheck in 48 hr to assure ↓ 5-10 mm Hg
enalapril	2.5 mg daily	2.5 mg daily q 4 weeks to max of 20 mg	hyperkalemia, angioedema, taste alteration, rash. Rarely, proteinuria, blood dyscrasia.	If DP < 115 mmHg, reevaluate in 2 weeks; then q 2-4 weeks
lisinopril	2.5 mg daily	2.5 mg daily q 4 weeks to max of 20 mg Higher doses of enalapril (40 mg) and lisinopril (80 mg) have been used.		Two measures after no talking for 5-10 minutes <u>Monitor for End Organ Damage:</u> If BP controlled and no TOD, get baseline serum creatinine, glucose, cholesterol, and UA. Follow-up q 5 yr <u>Monitor ACE Toxicity:</u> Check potassium and creatinine q 6

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
<u>Beta Blockers</u> nadolol	20 mg daily	20 mg daily q 4 weeks to max of 80 mg	Asthma, bradycardia, AV conduction defects, nasal congestion, LVF, CNS symptoms, fatigue, lethargy, impotence	<u>Monitor for Beta Blocker Toxicity:</u> Check for bradycardia and heart failure Inquire about depression, sexual dysfunction, insomnia, cold extremities
atenolol	25 mg daily	25 mg q 4 weeks to max of 100 mg		

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
<u>Ca Blockers</u> diltiazem	30 mg q 6 hr SR: 60 mg bid CD: 180 mg daily	Regular: 30 mg qid q 4 weeks to max of 360 mg LA: 60 mg/d q 4 weeks to max of 300 mg (SR or 360 mg (CD) 10 mg tid q 4 weeks XL: 30 mg daily q 4 weeks to max of 90 mg/day	Edema, headache, bradycardia, GI disturbances, dizziness, AV block, congestive heart failure, urinary frequency	<u>Monitor for Ca Blocker Toxicity:</u> Check for weight gain or peripheral edema; may be managed with dosage reduction or diuretics Check pulse, CHF signs Ask about constipation and dizziness
nifedipine	10 mg tid XL: 30 mg daily			
verapamil	80 mg q 8 hr SR: 120 mg daily; doses > 240 mg given bid	80 mg tid q 4 weeks to max of 360 mg; SR: 120 mg daily to max of 480 mg daily		

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
<u>Alpha-1 Blockers</u> prazosin	0.5 mg bid or tid X 3 days; first dose at bedtime	Increase to 1 mg bid/tid for at least 3 days. Increase by 1 mg/day q 2-4 weeks. Usual antihypertensive dose 6-15 mg/d in 2-3 divided doses. Maximum dose 20 mg/d. Usual BPH dose 1-5 mg bid.	Syncope with first dose, postural hypotension, dizziness, palpitations, headache, weakness, drowsiness, sexual dysfunction, anticholinergic effects, urinary incontinence, first-dose effects may be less with doxazosin.	Monitor <u>Alpha Blocker Toxicity</u> . Ask about dizziness and postural hypotension Postural B/Ps Elderly have increased hypotensive side effects and risk of hypothermia Check edema, weight gain, pulse/-palpitations, urinary incontinence.
terazosin	1 mg daily at bedtime	Increase 1 mg/d q 4 weeks to max 20 mg/d. Usual hypertensive doses 1-5 mg/d; BPH doses 5-10 mg/d. Samples: 1 mg X 3 d; 2 mg X 12 d; 5 mg X 5 d.		

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DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
<u>Angiotensin II Blockers</u> losartan/Cozaar losartan/Hyzaar	50 mg once daily	25-100 mg in 1 or 2 doses	Dizziness	<u>Monitor Drug Toxicity:</u> Inquire about upper respiratory infection, dizziness, headache Check serum creatinine q 6 months, especially if on diuretics or CHF
	50 mg plus hydrochlorothiazide 25 mg once daily	one or 2 tablets once daily	Dizziness plus hydrochlorothiazide side effects	
<u>Central Sympatholytics</u> clonidine methyldopa	0.1 mg bid 0.1 mg/d patch weekly	0.2-0.6 mg in 2 doses 0.1-0.3 mg/d patch weekly	Sedation, dry mouth, sexual dysfunction, headache, bradyarrhythmias, side effects may be less with guanfacine. Contact dermatitis with clonidine patch. Methyldopa also causes hepatitis, hemolytic anemia, fever	<u>Monitor For:</u> "Rebound" hypertension may occur even after gradual withdrawal. Methyldopa should be avoided in favor of safer agents.
	250 mg bid	500-2000 mg in 2 doses		

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
Peripheral Adrenergic Antagonists guanethidine	10 mg once daily	10-100 mg q d	Orthostatic hypotension, diarrhea, exercise hypotension, sexual dysfunction, salt and water retention.	Monitor: Use of tricyclic antidepressants
reserpine	0.05 mg once daily	0.05-0.25 mg q d	Depression (especially from reserpine but less likely at low dosages, i.e., <0.25 mg) night terrors, nasal stuffiness, drowsiness, peptic disease, gastrointestinal disturbances, bradycardia.	

DRUG GROUP	INITIAL DOSING	TITRATING DOSE	ADVERSE EFFECTS	MONITORING
<u>Direct Vasodilators</u> hydralazine	25 mg bid	50-300 mg in 2-4 doses	GI disturbances, tachycardia, headache, nasal congestion, rashes, LE-like syndrome	<u>Monitor:</u> May worsen or precipitate angina.
minoxidil	5 mg once daily	5-40 mg q d	Tachycardia, fluid retention, headache, hirsutism, pericardial effusion, thrombo- cytopenia.	Should be used in combination with beta blocker and diuretic.

Sources: Kuhn, M. A. (1994). Pharmacotherapeutics: A nursing process approach (3rd ed.). Philadelphia: F. A. Davis.
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ACCESS TO HEALTH CARE IN RURAL ENVIRONMENTS:
A CASE STUDY OF GREEN COUNTY, ALABAMA¹

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ABSTRACT

Public transportation systems including rail, bus and special-need conveyances are among the most important types of services provided by federal, state and local governments. Various modes of public transportation have been developed to facilitate both inter and intra-urban movement primarily within the context of built-up areas. However, well developed, integrated movement systems serving predominantly rural areas have not been fully developed in most states. Due to the inadequacy of rural public transportation systems a vast majority of the rural population is deprived of essential services and opportunities including access to health care, education, employment, retail and other cultural and recreational activities. Importantly, rural environments (where a large proportion of the population is elderly, with low income levels and a high demand for health care services) need an efficient, integrated transportation system in order to provide access to these essential resources. It is within this context that this study examines the role of Geographic Information Systems, GIS, as a planning tool for improving health care access in rural environments. Specifically, the study utilizes GIS to identify "efficient" movement corridors linking areas of population with a high demand for health care to existing health care centers in Green County, Alabama.

INTRODUCTION

Public transportation systems including rail, bus and special-need conveyances are among the most important types of services provided by federal, state and local governments. However, well developed, integrated movement systems serving predominantly rural areas have not yet been fully developed in most states (Saltzman, et al., 1974; Burkhardt 1981). Due to the inadequacy of rural public transportation systems a vast majority of the rural population is deprived of essential services and opportunities including access to health care, shopping, child care, education, and other cultural and recreational activities. In turn, this lack of accessibility to basic resources diminishes the likelihood of individuals residing in rural environments becoming productive, integrated

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members of society. Namely, restricted mobility and limited job opportunities characteristic of rural populations often lead to undereducation, underemployment, unemployment and ultimately to impoverished living conditions. Burkhardt (1981) states that inadequate public transportation networks are responsible for 1) absence of social and cultural contacts within a society, 2) restriction of social and economic self-improvement, 3) a significant disparity in lifestyle between the "transportation advantaged" and the "transportation disadvantaged"² and 4) failure to respond to important social, cultural and economic opportunities. Such a characterization of the rural population and its accompanying problems is compounded by inaccessibility to health care services including hospitals, physician offices, and specialized health care centers. (Annis 1981; Joseph and Phillips 1984; Joseph 1987; Greenberg 1987).

Importantly, rural environments (where a large proportion of the population is elderly, with low income levels and a high demand for health care services) need an efficient, integrated transportation system in order to provide access to these essential resources. It is within this context that this study examines the role of Geographic Information Systems (GIS) as a planning tool for improving health care access in rural environments. (Antenucci et al., 1991; Zhang 1992). Specifically, the study utilizes GIS to identify "efficient" movement corridors linking high demand health care populations to existing health care centers in Greene County, Alabama.

Historical Evolution of Rural Transportation Planning.

Government legislation on public transportation began in the early 1960s, when the Urban Mass Transportation Act (UMTA) and the Economic Opportunity Act (EDA) stimulated numerous efforts to develop efficient, integrated public transportation programs across the United States.

However, not until the McCone Commission submitted its report on racial riots in Watts-Los Angeles, California in 1965 did the concept of public transportation draw national attention (Saltzman 1974; Kaye 1978; Saltzman 1978; Fravel 1990). These studies report that the inadequacy of movement opportunities was the major cause of poverty, claiming a direct link between the lack of urban public transportation systems to employment centers with the high levels of unemployment and poverty. While a vast majority of the literature investigating the cause-and-effect linkages between the availability of public transit programs and poverty has been conducted within the context of urbanized areas, populations in rural environments often face similar social and economic issues (Reid, et al., 1984; Walther 1990). However, there exists a significant contextual difference between urban and rural environments that exacerbates the social

²TRANSPORTATION DISADVANTAGED: Any non-institutionalized person who cannot carry out a reasonable level of desired activity outside the home due to age, economic condition, physical or mental handicap, or lack of available vehicle or transportation service. The term disadvantaged is used to indicate persons with a transportation disadvantage, or with restricted mobility (Hauser, et. al. 1974).

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and economic challenges confronted by the rural population. First, public services and public service facilities are considerably more restricted in quantity in rural areas. Second, the location of public service facilities in rural areas are geographically more concentrated (i.e., the intervening distance separating the prospective user population and the service facility is greater). As a result, many residents in rural communities, especially those who are transportation disadvantaged, do not have access to those facilities and are less able to take advantage of their services. This immobility compounds the social and economic isolation fostered by distance alone.

Traditionally, there has been few research efforts devoted to rural transportation planning and rural public services. It was not until 1978 that the U.S. Department of Agriculture initiated a national survey of small towns and rural communities (National Rural Community Facilities Assessment Study) to determine the availability and condition of rural highways and selected rural services. This study provided an extensive baseline data bank and dramatically enhanced the dimension and scope of research in rural communities (Stocker 1985). While Stocker's concern was with the overall set of public services including water, sewage, education, fire protection, among others, the focus of this study is on health care and its accessibility through rural transportation networks. In particular, this study attempts to: (1) determine how rural movement systems influence the degree of accessibility between rural populations and health care centers and (2) assess the current status of rural transportation systems and identify which groups of people in rural communities are most negatively impacted by the lack of adequate movement opportunities.

In the United States there exists more than 45,000 rural communities within which movement is highly restricted and geographically channeled. Not only do rural areas exhibit a spatially scattered settlement pattern but they also possess few public facility "centers" that exhibit a high degree of geographic concentration. For example, Greene County, Alabama, has only 6 health care service facilities all of which are located in the single urban area of Eutaw (Census of Retail Trade of Alabama, 1987). By comparison, there exists a greater number and geographic dispersion of health care facilities in the more urbanized neighboring counties of Tuscaloosa and Jefferson; 177 and 1,125 respectively (Census of Retail Trade of Alabama, 1987). Similarly, the total number of drug stores in Greene County is only 2 compared to 37 and 211 drug stores in Tuscaloosa and Jefferson Counties respectively. While a majority of rural communities have access to three or more hospitals within a 30 mile radius, health care facilities providing higher-order, specialized services including neonatal intensive care, hemodialysis and cancer treatment are available only at considerably greater distances (Reid, et al., 1984).

In addition, rural communities, along with small urban settlements, contain nearly one-third of the nation's population and more than one-half of its low income households.

Private automobile ownership in rural areas is generally low. Fifteen percent of all rural households have no automobile (45 percent of the rural elderly have no automobile) and an additional 52 percent of rural households have only one vehicle (meaning that the family is often without transportation while the primary wage-earner is at work). Finally, the vast majority of automobiles that are privately owned by rural households are in disrepair. Within the above context, three groups of households are particularly "transportation disadvantaged" (1) the elderly, (2) the disabled and (3) those who do not own a private vehicle for economic or other reasons. For these households, who represent the vast majority of a rural community's population, the lack of private and public transportation opportunities compounds the twin issues of distance and limited number of health care facilities in restricting access to health care services.

In an effort to overcome or at least minimize the adverse impacts of these issues, public service facility development and location in rural areas should become sensitized to basic planning principles including effectiveness, accessibility, and equity and efficiency. While conventional planning approaches have focused on inventories of existing transportation resources including available modes, travel patterns, household attitudes, trip purpose, among others; two important planning questions remain. First, what is the degree of linkage or accessibility between a rural area's transportation system and the public service needs of its population, in general, and health care services, in particular? Second, as a rural community's age, health care need, and socio-economic profile change what modifications to the area's existing transportation system are necessary to maintain an appropriate level of accessibility? While traditional rural transportation planning approaches have only minimally addressed these two questions, an emerging technology Geographic Information Systems possesses the analytical capability of better resolving these issues.

THE STUDY AREA

Greene County is located in west-central Alabama with a total area of nearly 650 square miles and a population slightly above 10,000 people (U.S. Bureau of the Census 1990). The city of Eutaw is Greene County's seat of government and is also considered to be its largest town. Because Greene County has no town (including Eutaw) with a population greater than 2,500, its population is considered to be 100 percent rural. According to the 1990 Census report the state of Alabama has eight of the nation's 100 poorest counties, of which Greene County ranks as the state's lowest with nearly 50 percent of its residents living at or below the poverty level (Birmingham Post-Herald, February 8, 1993). In particular, the level of poverty among African Americans in this county exceeds that of whites by 47.1 percent while the percent of people 65 years and older living below the poverty level is 46.3.

Moreover, according to a report in the Tuscaloosa News on June 26, 1995, 58.3 percent of the population under the age of 18 live below the poverty level. While these very high proportions of Greene County's population are trends in poverty, they create a high demand for a variety of health care services.

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Geographic Information Systems is defined as a system of computer hardware, software and procedures designed to support the capture, management, manipulation, analysis, modularity and display of spatially referenced data for solving complex planning and management problems (Antenucci, et al., 1991).

Importantly, other economic, demographic and social characteristics of Greene County, in particular, and the state of Alabama, in general, support this relationships between health care needs and accessibility of low income, rural populations (Table 1).

In general, the data indicate that Greene County has a relatively low median household income (\$11,990), a high unemployment rate (14.1%), a high dependency ratio (whereby over 50 percent of the population is either under 18 or over 65 years of age), a low ownership of private vehicles (25 percent of the population do not own a vehicle and an additional 34 percent own only one vehicle), a low population density of less than 16 persons per square mile, and a poor quality of housing units (no public sewer connections 33%; not equipped with heating or cooling systems, 15.4%; no plumbing, 22.7%). These socio-economic conditions increase substantially the population's exposure to seasonal illnesses and systemic diseases requiring frequent contact with medical services and, therefore, having access to a transportation system that connects residents to health care centers.

The Geography of Health Care and Transportation in Greene County.

Green County has one hospital, one nursing home, two dental offices, one health care center and two drug stores, all of which are located in the city of Eutaw (Figure 1). With a staff of only eight physicians and 16 nurses, Greene County Hospital serves less than 30 patients per day and provides a limited set of basic medical services. Comparatively, in 1994, medical records indicate that over 800 Greene County residents were admitted to DCH Regional Medical Center for in-patient services. The total number of individuals receiving outpatient care exceeded 3,000. Included in these statistics are Greene County residents who required regular treatment for recurring therapy, cancer treatment, laboratory tests and X-rays. The number of patients who visited the Rehabilitation Pavilion was 20, while nearly 2,000 individuals utilized the Emergency Department. Finally, a total of 65 Greene County pregnancies were born in the Maternity Ward of DCH Regional Medical Center. In short, these records suggest that a substantial proportion of demand for ordinary and especially higher-order, specialized health services by the population of Greene County is supplied by DCH, a health care facility located over 40 miles away.

According to the U.S. Department of Transportation (1991) 120 miles of Greene County's roads belong to the state system, 479 miles are part of the county system and 27.9 miles are in the interstate system (Figure 1). Calculating total mileage of roads included in the county, state and interstate systems and dividing it by the total area of the county generates a road density of only .98 for Greene County,

nearly 30 percent less than the statewide average. Finally, the county has 121 bridges, however, 62 are structurally deficient and functionally obsolete (Association of County Engineers of Alabama 1986).

While Green County and other surrounding West Alabama counties are served by West Alabama Public Transportation and West Alabama Health Services averaging nearly 300 people daily, it remains clear that these impoverished rural counties possess only a skeletal transportation network and operate a minimally functioning public transportation program. As a result, the mobility of the vast majority of Greene County residents who are directly dependent upon public transportation is highly restricted. Specifically, although there exists a high demand for medical services by Greene County residents, health care centers are few in number, offer a limited range of basic services and are relatively geographically inaccessible (Table 2). While additional health care centers strategically placed throughout the county would substantially improve the present geographic inequity in linking health care needs to health care services, there is too little tax base support in Greene County to fund such additional facilities. Therefore, it appears that improving rural public transportation services primarily funded through state and federal programs represents the only viable option.

To actualize this option, this paper determines those areas where improvements in public transportation services could better serve the health care needs of Greene County. In particular, GIS is used to identify "efficient" movement corridors linking high demand health care populations to the existing health care centers in Greene County.

THE ANALYSIS

Within Greene County there are four census tracts, 11 block groups (Table 3) and 891 blocks. Each block group is assigned an identification number (Figure 2). The variables used in the study examine four different categories of "transportation disadvantaged" individuals: 1) population 65 years and greater, 2) tenure by vehicles available (none) per occupied housing unit, 3) tenure by vehicles available (one) per occupied housing unit and 4) income below \$15,000 per household. For each variable, data is collected at the block group level from the 1990 Census of Population and Housing summary tape file 3A. Percentages for each variable (Table 4) are compared against the countywide average and are divided into three categories: below average, near average and above average. For the variables percent of population over 65 years, percent of occupied housing units with no vehicles and percent of households whose annual income is less than \$15,000, the greater in value the percentages are compared to the countywide average, the greater is the need for a public transportation program. On the other hand, for the variable tenure by vehicles available (one) per occupied housing unit, the greater in value the percentage is compared to the countywide average the less is the need for such a program. Figures 3a-3d illustrate the spatial distribution of each of the four groups of "transportation disadvantaged" residents of Greene County, by block group.

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In general, the percent of Greene County's population over age 65 years that is greater than the countywide average is concentrated in the central portion of the county; whereas the southeast and the northern sections of the county house a population which tends to be younger or which falls below the countywide average (Figure 3a). On the average, 25 percent of all occupied housing units of Greene County are without any vehicles while nearly 35 percent of the occupied housing units of block group number 10 do not have any vehicles. Six other block groups (numbers 2, 4, 5, 6, 9 and 11) situated primarily in the western and southern parts of the county also have higher percentages (ranging from 26% to 35%) of occupied housing units with no vehicles as compared to the countywide average (Figure 3b). While this condition is slightly better for block groups (numbers 1, 3, 7 and 8) the percentages of occupied housing units without any vehicles remains significant ranging from 13 to 16 percent.

Importantly, for variable 3, percent of occupied housing units with one vehicle, a large percentage difference below the countywide average (34%) suggests a greater need for a public transportation program. Figure 3c illustrates that block groups located in the east-central eastern, southern and northwestern parts of the county have lower percentages of occupied housing units which own one vehicle as compared to the countywide average (percentages range between 25 and 31 percent). By contrast, block groups located in the northern, northeastern, north-central, southwestern and west-central parts of the county have a greater percent of households above the countywide average, ranging from 34 to 45 percent. Finally, except for two block groups situated in the central part of the county (numbers 7 and 8) all other block groups have between 50 to 69 percent of their households with an average annual income below \$15,000 as compared to the countywide average of 57 percent (Figure 3d).

In summary, six of the eleven block groups in Greene County have an above countywide average of the population belonging to the age group 65 years or older while seven of the eleven block groups have an above countywide average of either 1) occupied housing units with no vehicle, 2) occupied housing units with one vehicle, or 3) households with income less than \$15,000 (Table 5). While a majority of block groups are in need of a public transportation program improving the accessibility of residents to health care centers, there is no dominating "transportation disadvantaged" group in the county. Therefore, on the basis of the total number of those groups and the percent of individuals belonging to such groups, each block group within the county is ranked based on a scale of "highest high, medium and low" indicating its priority for receiving a public transportation program. If the percentages for all four variables are higher than their respective countywide averages in a given block group, then that block group has the highest proportion of all four groups of "transportation disadvantaged" residents and is thus assigned the "highest" priority for receiving a public transportation facility. Similarly, if the percentages for any three variables are higher than their respective countywide averages in a given block group, then that block group is assigned a "high" priority. This process is continued until all of the block groups are identified with one of the four levels of priority. Figure 4 and Table 6 illustrate the final rankings for all block groups in Greene County.

Moreover, the barriers of distance and accessibility are compounded by the county's low population density. Six out of the eleven block groups that possess a high proportion of "transportation disadvantaged" residents also have a low population density, ranging from 8 to 18. This combination, along with significant intervening distances, measurably restricts the mobility of the county's population and hence further diminishes their access to available health care centers.

CONCLUSIONS

While Greene County's minimal transportation network contributes to the poor accessibility between county residents and available health care facilities, the need for improved public transportation by block group is primarily a function of the "transportation disadvantaged" groups that characterize the county's population. While nearly all block groups demonstrate a clear need for public transportation assistance, this study outlines a hierarchical approach in which a public-assisted transportation program may be devised and implemented. Specifically, a cost/benefit model may be used to evaluate alternative public transit service route systems as such systems are developed to connect sequentially the highest-to-lowest need block group populations identified by the GIS model.

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Table 1. Selected Social, Economic and Demographic Characteristics of Greene County, 1990.

Characteristic	Greene County	Alabama
Population Density	15.7	76.7
Total Population	10,153	4,040,587
Age Structure		
under 18 years	35.6%	29.8%
18 to 64 years	48.1%	58.9%
65 years +	16.2%	11.3%
Housing Units		
air conditioning	15.4%	36.6%
public sewer	33.0%	53.6%
plumbing	77.3%	95.8%
Median income	\$15,663	\$28,300
Per capita income	\$ 9,903	\$14,899
Unemployment rate	14.1%	7.5%
Education Level		
High School	39.9%	56.5%
College	9.6%	12.2%
Crude Birth Rate	18.2	15.7
Crude Death Rate	16.2	10.9
Births to Teenage Mothers	19.9%	18.2%
Births to Unmarried Women	64.5%	32.6%

Source: Alabama Department of Community Affairs, 1990; Alabama County Data Book, 1990; U.S. Bureau of Census of Population and Housing Summary Tape file 3A, 1990.

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Table 2. Network distance between select towns in Greene County and Eutaw.

<u>Town</u>	<u>Distance (miles)</u>
Boligee	10
Union	11
Forkland	13
Allison	7
Birdeye	15
Pleasant Ridge	15
Clinton	7
Lewiston	15
Mantua	15
Knoxville	10
Mt. Hebron	10
West Greene	13

Source: U.S. Bureau of Census, 1990. TIGER/Line Files.

Table 3. Greene County population by census tract, block group and block group ID, 1990.

Census Tract	Block Group	Block Group ID	Total Population
9743	9743-1	1	1,167
	9743-2	2	941
9744	9744-1	3	628
	9744-2	4	459
	9744-3	5	549
	9744-4	6	1,393
	9744-5	7	793
	9744-6	8	1,006
9745	9745-1	9	1,064
9746	9746-1	10	859
	9746-2	11	1,294
TOTAL			10,153

Source: U.S. Bureau of Census, 1990. Census of Population and Housing Summary Tape File 3A and County Block Map of Greene County, Alabama.

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Table 4. Percent of Greene County's population in a "transportation disadvantaged" group by block group ID.

Block Group ID	Population 65 Years or greater %	Occupied Housing Units with no Vehicle %	Occupied Housing Units with one Vehicle %	Households with Income Below \$15,000 %
1	12	16	34	60
2	20	30	29	59
3	20	13	45	53
4	22	32	28	51
5	13	26	31	57
6	9	27	47	65
7	19	15	31	40
8	20	14	39	46
9	19	29	39	67
10	12	35	25	63
11	14	34	25	59
Countywide Average	16	25	34	57

Source: Compiled by authors.

Table 5. Block Groups with a high proportion* of households belonging to a “transportation advantaged” group.

Transportation Disadvantaged Groups	Block Group ID	Total Number of Block Groups
Population 65 years or greater	2,3,4,7,8,9	6
Occupied housing units with no vehicles	2,4,5,6,9,10,11	7
Occupied housing units with one vehicle	1,2,4,5,7,10,11	7
Households with income less than \$15,000	1,2,5,6,9,10,11	7

Source: Compiled by authors.

*A block group is considered to have a high proportion if the calculated percentage for a given “transportation disadvantaged” group is greater than the established countywide average.

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Table 6. Total number of high proportion "transportation disadvantaged" groups by block group ID and their calculated rank-order for receiving a public transportation program.

Block Group ID	Age 65 Years or Greater	Occupied Housing Units with no Vehicle	Occupied Housing Units with one Vehicle	Households with income below \$15,000	Total Number	Ranking
1	x		x	x	2	Medium
2	x	x	x	x	4	highest
3	x				1	low
4	x	x	x		3	high
5		x	x	x	3	high
6		x		x	2	medium
7	x		x		2	medium
8	x				1	low
9	x	x		x	3	high
10		x	x	x	3	high
11		x		x	3	high

Source: Compiled by authors

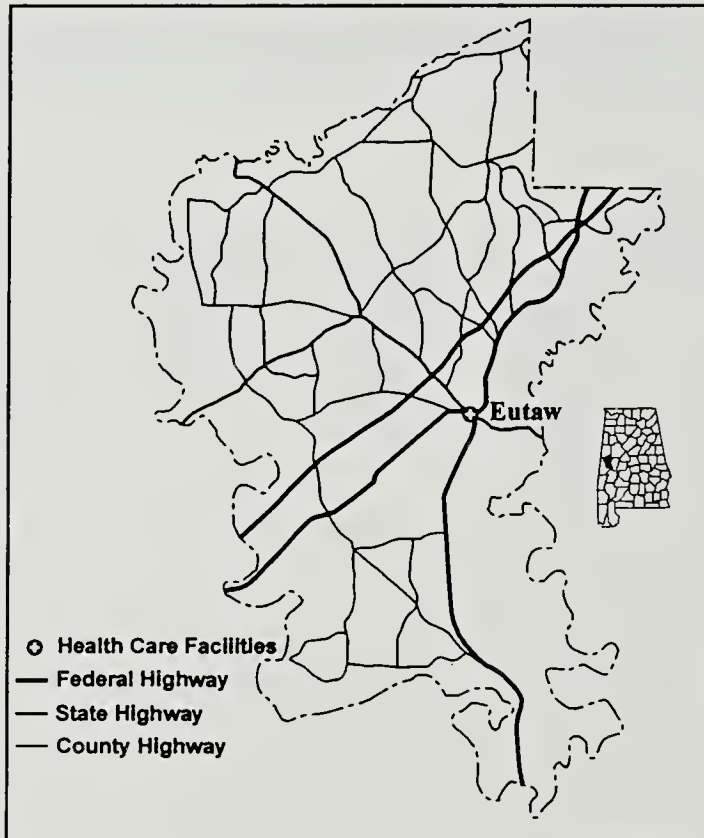


Figure 1. Road Network and Health Care Facility Location in Greene County, Alabama

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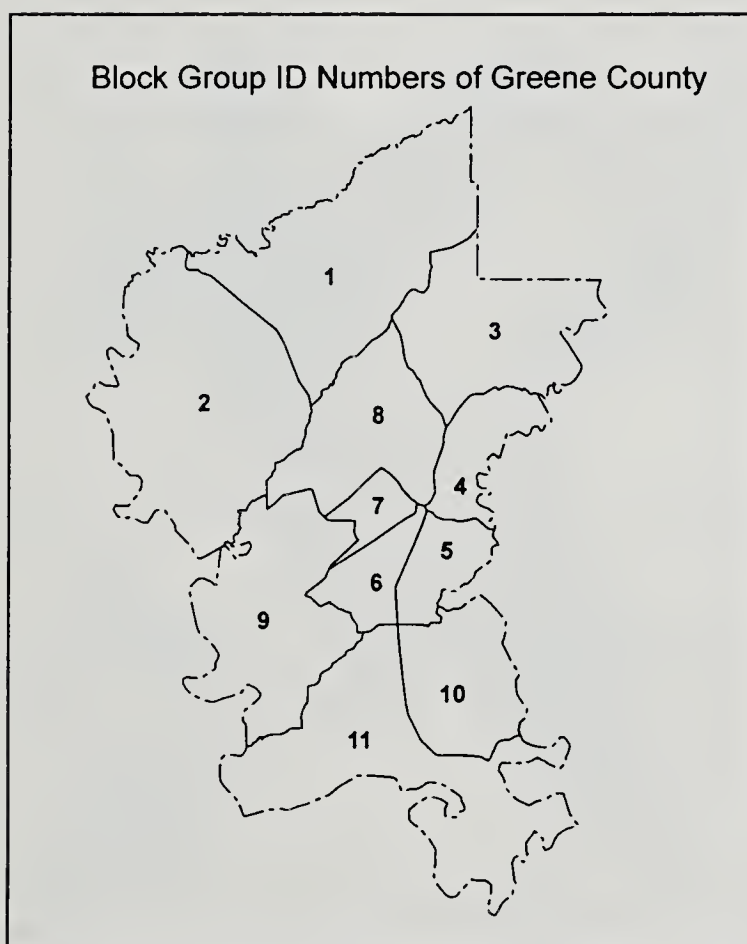
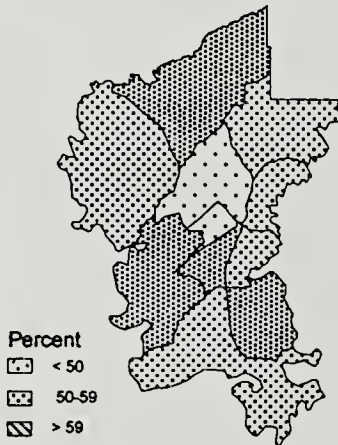


Figure 2. Block Group ID Numbers of Greene County, Alabama



by Transportation Disadvantaged Group and Block ID Number.

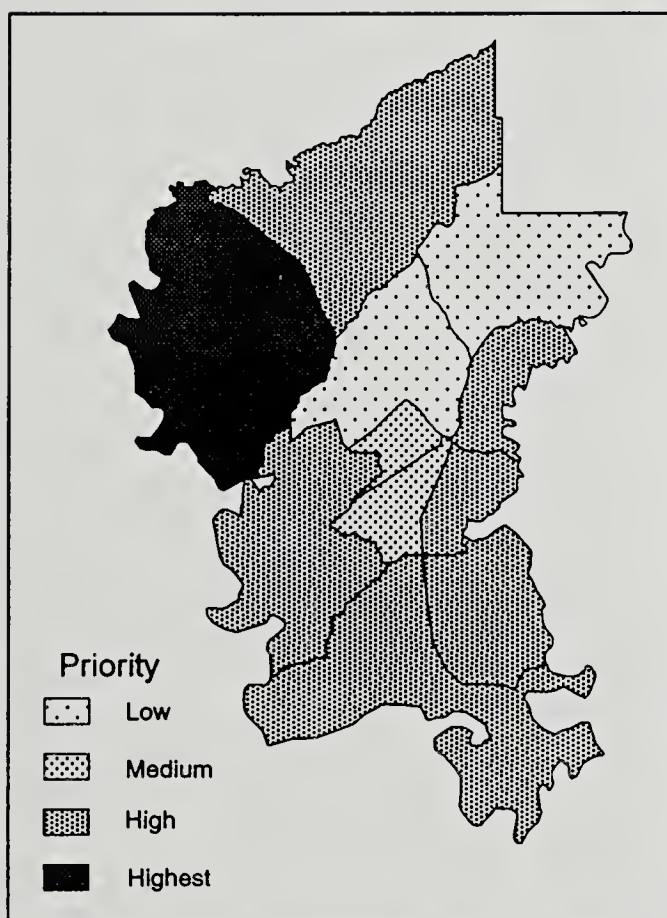


Figure 4. Priority Need for a Public Transportation System by Block Group ID Number.

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COVER PHOTOGRAPH: This photograph of the Cahaba lily (*Hymenocallis coronaria*), contributed by L. J. Davenport, was taken at Buck Creek near Helena, Shelby County, Alabama--the longest continuously monitored lily population in the state.

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BREFELDIN A ALTERS FAT BODY VITELLOGENIN SECRETION
IN THE STICK INSECT *CARAUSIUS MOROSUS* Br.

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ABSTRACT

In oogenic insects, vitellogenins (Vg) are synthesized in the fat body and secreted into the hemolymph for uptake by developing follicles. To examine aspects of vitellogenesis in the stick insect *Carausius morosus*, fat body was subjected *in vitro* to varying concentrations of Brefeldin A (BFA), an inhibitor of intracellular protein transport, and the effects were analyzed by SDS-PAGE-fluorography. Electrophoretic and fluorographic analyses of fat body tissue incubated in ³⁵S-methionine and BFA indicated that although pre-Vgs became labeled at all BFA concentrations, *in vitro* secretion of labeled Vg polypeptides by the fat body was decreased at 5-10 µg/ml BFA, and was completely inhibited at 20 µg/ml. Secretion of labeled Vgs was unaffected by exposure to BFA concentrations of 0.5-1.0 µg/ml. Lack of accumulation of labeled Vg polypeptides in the presence of labeled precursors in BFA treated fat body suggests that BFA may interfere with Vg processing in *Carausius* fat body as well as Vg secretion. To our knowledge this report is the first describing the action of BFA on protein secretion in an invertebrate.

INTRODUCTION

The insect fat body is the site of many metabolic processes including the synthesis of the yolk protein precursor, vitellogenin (Vg), in oogenic females (Pan *et. al.*, 1969; Hagedorn and Kunkel, 1979; Kunkel and Nordin, 1985). Vitellogenins are glycopospholipo-secretory proteins that undergo co- and post-translational processing in the insect fat body (Kunkel and Nordin, 1985), but few details are known about the molecular events associated with Vg secretion. Previous studies have examined various aspects of vitellogenesis, oogenesis and embryogenesis in the parthenogenic stick insect, *Carausius morosus* Br. (Giorgi and Macchi, 1980; Giorgi *et. al.*, 1982; Bradley and Giorgi, 1986; Masetti and Giorgi, 1989; Giorgi *et. al.*, 1993a, 1993b).

Unlike other hemimetabolous insects, vitellogenesis in *Carausius* can occur independently of the corpora allata, suggesting that induction of Vg synthesis is juvenile hormone-independent (Bradley and Giorgi, 1986). Therefore, a thorough understanding of the cellular and molecular events associated with Vg synthesis and secretion in this species holds special interest.

Proteins, whether destined to become cell membrane components, to be incorporated into lysosomes, or to be secreted, must be transported from the site of synthesis in the rough endoplasmic reticulum (ER) through the Golgi complex. The steps involved in the transport of proteins through the ER and Golgi complex have been extensively studied (see reviews by Farquhar and Palade, 1981; Burgess and Kelly, 1987; Mollenhauer and Morré, 1991) and the importance of the Golgi complex in mediating intracellular transport via protein targeting and post-translational processing is well documented (Farquhar, 1985; Pfeffer and Rothman, 1987). Nevertheless, the precise mechanisms involved in the sorting and processing of proteins by the Golgi complex remain under investigation.

Brefeldin A (BFA) is a fungal metabolite (Härri *et. al.*, 1963) which specifically and reversibly blocks the intracellular translocation of proteins from the ER to the Golgi in several cell types without blocking endocytosis, protein synthesis, or lysosome function (Misumi *et. al.*, 1986; Takatsuki and Tamura, 1985). BFA also causes ultrastructural changes in the Golgi complex which are reversible (Fujiwara *et. al.*, 1988; Koriyama *et. al.*, 1989) and causes a reversible redistribution of Golgi membranes and enzymes such as TPPase and other Golgi protein markers to the ER (Doms *et. al.*, 1989; Fujiwara *et. al.*, 1989; Lippincott-Schwartz *et. al.*, 1989; Orci *et. al.*, 1991). Several studies have reported the effects of BFA on mammalian cell systems (Misumi *et. al.*, 1986; Fujiwara *et. al.*, 1988; Lippincott-Schwartz *et. al.*, 1991a; Ulmer and Palade, 1991b), fungi (Arioka *et. al.*, 1991; Bourett and Howard, 1996), plant cells (Kaneko *et. al.*, 1996), viral assembly (Takatsuki and Tamura, 1985; Ulmer and Palade, 1991a, 1991b) and cell-free systems (Orci *et. al.*, 1991).

In this study we examine the effects of BFA on insect Vg synthesis, processing, and secretion using SDS-PAGE and fluorographic analyses. *C. morosus* fat body secretes two native multimeric Vgs, Vg A (540 kD) and Vg B (276 kD), which can be resolved by SDS-PAGE into five Vg polypeptide subunits, A₁, A₂, A₃, and B₁ and B₂, respectively. The subunit molecular weights range from 54 kD to 180 kD (Giorgi *et. al.*, 1982, 1993b). Because of the large amounts of Vg produced and secreted by the vitellogenic fat body, the tissue offers an opportunity to study basic biological mechanisms such as intracellular protein processing; moreover, examining vitellogenesis in *C. morosus* provides a means for gaining comparative insights into the evolution of mechanisms regulating insect reproduction.

MATERIALS AND METHODS

Experimental animals

Carausius morosus were maintained in glass aquaria on a diet of fresh ivy leaves *ad libitum* under ambient room temperature. Fat body tissue was obtained by dissection of abdominal segments from mature egg-laying individuals selected from a stock population.

In vitro labeling of fat body proteins

In vitro labeling of the fat body was accomplished by incubating samples of approximately 0.25 fat body equivalents from three egg-laying adult *C. morosus* in 100 μ l of Grace's Insect Cell Culture Medium (Gibco Laboratories, Grand Island, NY) containing 10 μ Ci of ^{35} S-methionine (^{35} S-met, specific activity 1070 Ci/mmol; New England Nuclear Research Products, Boston, MA) in wells of a sterile 96-well tissue culture plate. Following a 10-min incubation period, tissues were rinsed twice in Grace's supplemented with 1mM L-met, and chased with supplemented Grace's for 0, 30, 60, 90, 120 and 180 min. The incubation medium and tissue from each timed sample were processed separately for sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and fluorography and assayed for total protein as detailed below.

Brefeldin A (BFA) treatment

C. morosus fat body was pre-incubated 2 hr at 28°C in Grace's Insect Medium containing BFA (Epicentre Technologies, Madison, WI) concentrations from 0-200 μ g/ml. Tissue was then transferred to fresh medium containing the same BFA concentrations and 10 μ Ci ^{35} S-met. Following a 3 hr incubation at 28°C, the fat body and incubation medium for each BFA concentration were processed for SDS-PAGE and assayed for total protein.

Electrophoresis, fluorography and immunoblotting

Vitellogenin polypeptides were separated by SDS-PAGE in 5-15% gradients using the method of Laemmli (1970). Fat body was washed three times in cold Tris-saline (0.05 M Tris, 0.2 N NaCl, pH 6.8), sonicated in cold Tris-saline containing 0.1 mM phenylmethylsulfonyl fluoride (PMSF), and centrifuged; the supernatant was then mixed with an equal part of SDS sample buffer (0.25 M Tris, 50% glycerol, 5% 2-mercaptoethanol, 5% SDS, pH 6.8). Incubation medium was mixed with an equal volume of SDS sample buffer. All samples were then heated 2 min at 100°C and stored at -70°C until use. Protein concentrations of sample aliquots were estimated using the Bio-Rad Protein Assay (Bio-Rad Laboratories, Hercules, CA). Gels to be fluorographed were fixed, stained with 0.1% Coomassie Blue R in 50% methanol and 10% acetic acid, and photographed. Stained gels were then soaked in Amplify (Amersham, Arlington Heights, IL) 30 min, 1% glycerol 45 min, and dried under heat and vacuum (Bio-Rad Model 224 slab gel dryer). Dried gels were overlaid with Kodak XAR-5 X-ray film for 1-7 days at -70°C. Fluorographs were processed with Kodak GBX Developer and Fixer.

Immunoblots were performed following transfer of SDS-PAGE separated polypeptides to nitrocellulose paper (NCP) using the method of Towbin (1979). Monoclonal antibodies (Mabs) were generated by standard hybridoma methods using spleen cells from Balb/c mice immunized with *C. morosus* vitellins isolated according to Giorgi *et. al.* (1982). Antibody binding on immunoblots was visualized using alkaline phosphatase-labeled anti-mouse IgG (Sigma Chemical Co., St. Louis, MO) and nitroblue tetrazolium/5-bromo-4-chloro-3-indolyl phosphate (NBT/BCIP) substrate.

RESULTS

Identification of pre-Vg polypeptides in the fat body

The two multisubunit hemolymph vitellogenins (Vg) and corresponding egg vitellins (Vt) of *C. morosus* have been characterized (Giorgi *et. al.*, 1982, 1993b). Previous studies of the kinetics of appearance of newly made fat body and hemolymph polypeptides indicated that these proteins are derived from high molecular weight polypeptides (≥ 200 kD) synthesized and processed by the fat body (Giorgi and Macchi, 1980; Giorgi *et. al.*, 1982).

In order to confirm the identity of Vg precursor polypeptides in the fat body, we examined the reactivity of fat body constituents from vitellogenically active insects with Mabs specific for *C. morosus* Vt polypeptides (Estridge *et. al.*, 1990) following SDS-PAGE and transfer to NCP. In addition to Vg polypeptides, three high molecular weight polypeptides, 225 kD, 230 kD, and 240 kD, were present in fat body (Fig. 1, left). Monoclonal antibody 3A11 reacted with Vgs B₁ and B₂ as well as with the 230 and 240 kD polypeptides; Mab 1B12 reacted with Vg A₃ and the 240 kD polypeptide; Mab 6F1 reacted with Vg A₃ and the 230 kD polypeptide. Our Mab data along with earlier kinetic data (Giorgi and Macchi, 1980) indicate a precursor-product relationship between these high molecular weight fat body polypeptides and the Vgs. Hereafter, these fat body polypeptides are referred to as pre-Vg polypeptides.

In vitro labeling and secretion of fat body proteins

To describe the normal time-course for synthesis/secretion of Vg polypeptides, an *in vitro* pulse-chase experiment using fat body from egg-laying adults was performed. Two pre-Vg polypeptides (225-230 kD) were labeled by the end of the 10-min pulse (time 0); by 60 min a third higher molecular weight (240 kD) pre-Vg band was labeled. All three pre-Vg bands remained labeled for the remainder of the 3 hr incubation period, but showed progressively weaker signals after 90 min (Fig. 2). Immediately after the pulse (time 0), Vg B₁ (180 kD) was faintly labeled in the fat body and by 30 min the signal was stronger (Fig. 2). Unlike the pre-Vg bands, fat body B₁ showed a strong signal through the 60-180 min incubation periods (Fig. 2).

No labeled Vg polypeptides were detectable in the incubation medium after 0 or 30 min chase periods. Labeled B₁ from the incubation medium was first detectable in fluorographs (but not recordable photographically) 1 hr after the pulse labeling. At 90 min,

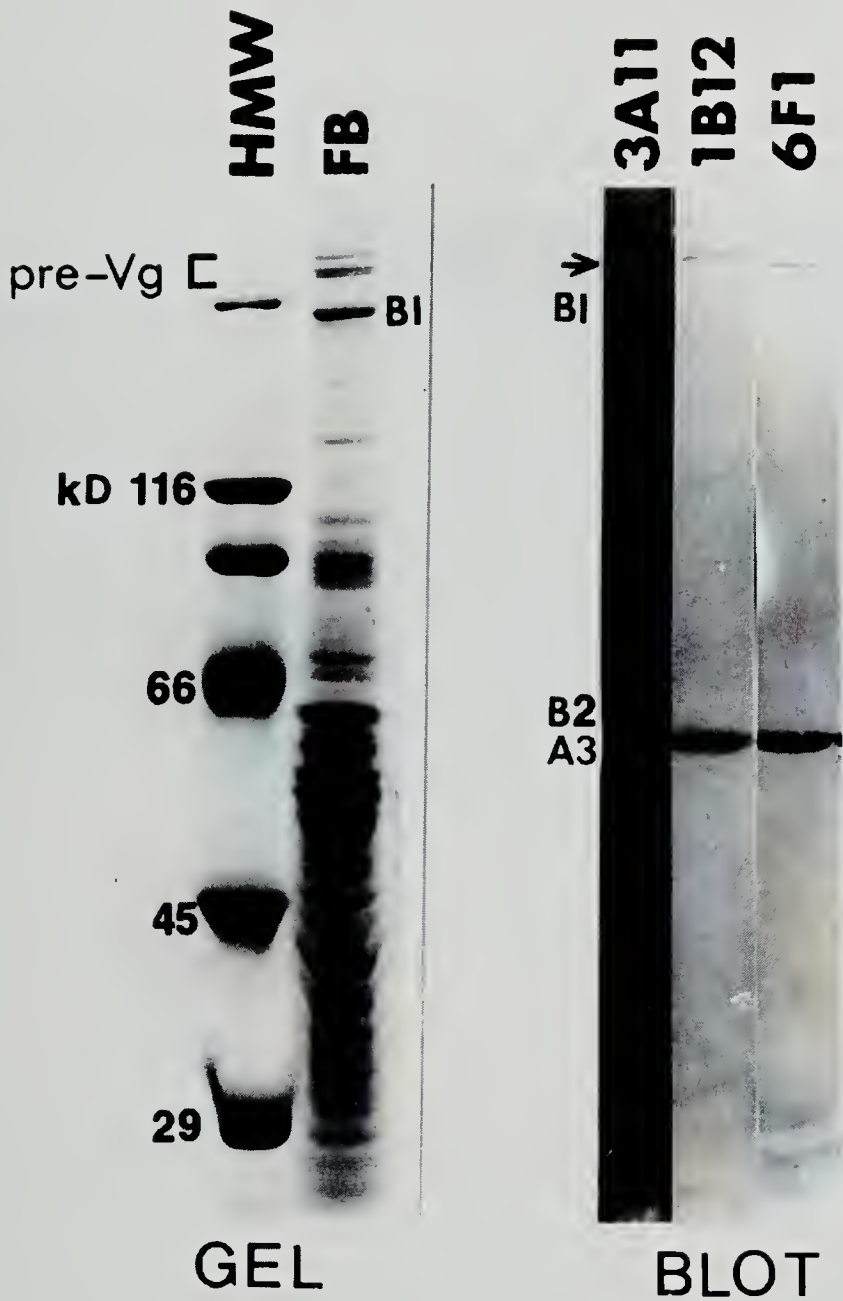


Figure 1. Immunoblots of *C. morosus* fat body proteins using three monoclonal antibodies (Mabs). Left, Coomassie blue-stained gel of fat body proteins (FB) and high molecular weight markers (HMW). Right, Western blots of Mabs 3A11, 1B12 and 6F1. Each Mab reacts with a Vg polypeptide as well as one or more pre-Vg bands (arrow). kD, kilodaltons.

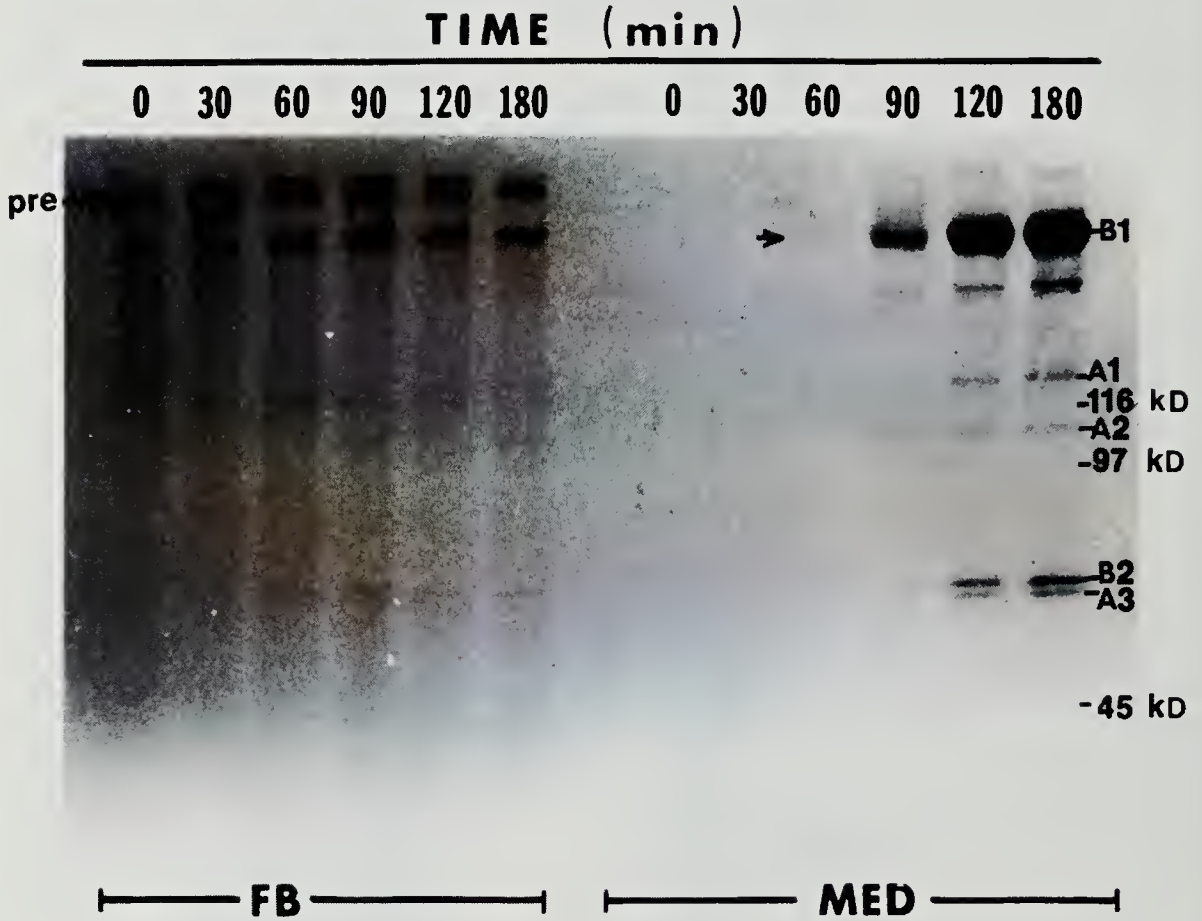


Figure 2. *In vitro* synthesis and secretion of Vg during ^{35}S -met pulse-chase labeling of *C. morosus* fat body polypeptides shown by fluorograph of SDS-PAGE gel. Two fat body pre-Vg bands were labeled immediately following the 10-min pulse (time 0); by 60 min, a third higher molecular weight pre-Vg was labeled. Labeled B₁ was present in small amounts in fat body from 0-180 min incubation; labeled B₁ in the incubation medium (arrow) was readily visible by 90 min; by 2 hr all five labeled Vg polypeptides (A₁-A₃, and B₁-B₂) were present in the medium. FB, fat body; MED, incubation medium; kD, kilodaltons.

labeled B₁ was prominent and by 120 min the incubation medium contained all 5 labeled Vg polypeptides (Fig. 2). The Vg polypeptides, especially B₁, accumulated in the incubation medium over the 3-hr period but did not accumulate in the fat body, indicating rapid Vg secretion following pre-Vg proteolytic processing. The first appearance of labeled B₁ in the medium 60 min following the pulse label suggests that approximately one hour is required for the Vg to become labeled and to traverse the secretory pathway.

Effect of BFA concentration on Vg secretion by fat body

To determine whether BFA affects secretion of Vg in *C. morosus*, and, if so, to approximate the effective dose, fat body tissue from three adults was exposed to BFA concentrations of 0, 10, 50, and 200 $\mu\text{g/ml}$ over a 5-hr period, including a 2 hr BFA pre-incubation period followed by a 3 hr period of exposure to ³⁵S-met in the presence of BFA. Tissues and incubation media were then analyzed by SDS-PAGE and fluorography.

Pre-Vgs and all five Vg polypeptides were labeled in fat body tissue incubated in 0 and 10 $\mu\text{g/ml}$ BFA; however, fat body from 50 and 200 $\mu\text{g/ml}$ BFA concentrations contained only labeled pre-Vg and labeled B₁ (results not shown). Certain non-Vg fat body polypeptides appeared equally labeled at all BFA concentrations. In the samples of incubation media, all five labeled Vg polypeptides were present in 0 (control) and 10 $\mu\text{g/ml}$ BFA samples, although the label was considerably less in the 10 $\mu\text{g/ml}$ sample. No labeled Vgs were detected in the 50 and 200 $\mu\text{g/ml}$ incubation medium samples. These results suggested a partial effect on Vg secretion at 10 $\mu\text{g/ml}$ BFA and complete inhibition of Vg secretion at the higher doses. Based on these results BFA concentrations from 0-20 $\mu\text{g/ml}$ were used for further experiments.

Figure 3 shows results from an experiment like that described previously using BFA concentrations of 0, 0.5, 1.0, 5.0, 10.0 and 20.0 $\mu\text{g/ml}$. At all BFA concentrations (0-20 $\mu\text{g/ml}$) the fat body pre-Vg polypeptides were labeled (Fig. 3). Polypeptide B₁ was also labeled but did not appear to accumulate in the fat body. Other Vg subunits were labeled in fat body at 0-10 $\mu\text{g/ml}$ BFA, but gave weak signals, suggesting that intracellular accumulation of the polypeptides was not occurring. No labeled fat body Vg polypeptides were detected at 20 $\mu\text{g/ml}$ BFA.

All five Vg polypeptides were labeled and secreted into the incubation medium at BFA concentrations of 0-10 $\mu\text{g/ml}$. At 5 and 10 $\mu\text{g/ml}$ the labeled polypeptides in the incubation medium appeared less concentrated than in the 0-1.0 $\mu\text{g/ml}$ BFA treatments. No labeled Vg polypeptides were detectable in the incubation medium containing 20 $\mu\text{g/ml}$ BFA (Fig. 3). Although protein assay and Coomassie blue-stained gels (not shown) indicated that similar amounts of total fat body protein existed in each lane, the level of protein labeling appeared greatly diminished at the 20 $\mu\text{g/ml}$ level. Similar results were obtained in replicate experiments. Complete inhibition of labeled Vg secretion occurred at 20 $\mu\text{g/ml}$ BFA, while it appeared that only partial inhibition of secretion occurred at 5-10 $\mu\text{g/ml}$ BFA.

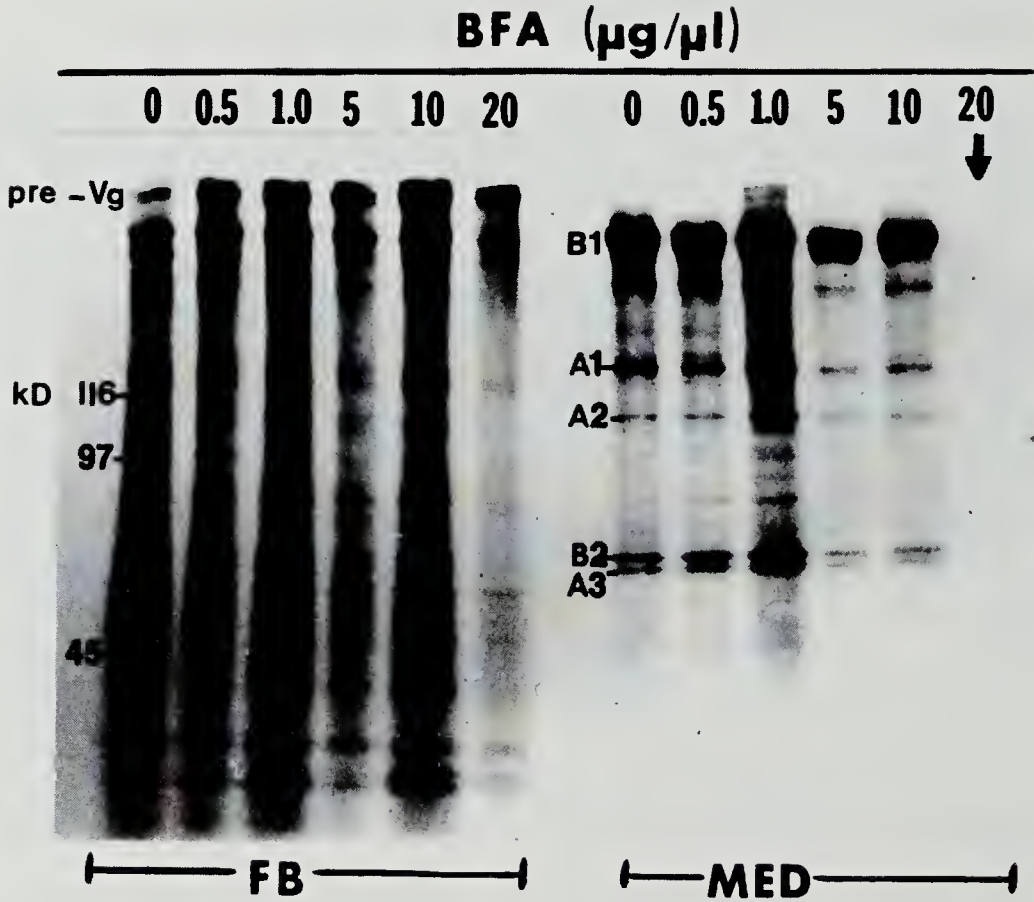


Figure 3. Fluorographic analysis of Vg synthesis and secretion in BFA-treated *C. morosus* fat body. Following a 2-hr pre-incubation in 0, 0.5, 1.0, 5.0, 10.0 and 20.0 $\mu\text{g}/\text{ml}$ BFA, fat body was incubated 3 hr with 10 μCi ^{35}S -met and BFA dilutions in Grace's medium (MED). Fat body pre-Vgs were labeled at all BFA concentrations; fat body Vg polypeptides were labeled at 0-10 $\mu\text{g}/\text{ml}$ BFA. Secretion of labeled Vg polypeptides into the medium occurred from 0-10 $\mu\text{g}/\text{ml}$ BFA, but concentrations of labeled Vgs appeared decreased at 5 and 10 $\mu\text{g}/\text{ml}$; at 20 $\mu\text{g}/\text{ml}$ BFA no labeled Vg polypeptides were detected in the medium (arrow). kD, kilodaltons.

BFA and Vitellogenin

Results of a preliminary experiment using *Acheta domesticus* fat body incubated with 0-20 $\mu\text{g/ml}$ BFA also showed accumulation (no secretion) of labeled fat body protein in samples exposed to 10 and 20 $\mu\text{g/ml}$ BFA; high molecular weight *Acheta* pre-Vgs were labeled at these concentrations. Labeled Vg was detected in the incubation media at 0-1 $\mu\text{g/ml}$ BFA, decreased labeled Vg at 5 $\mu\text{g/ml}$ BFA, and no labeled Vg at 10 and 20 $\mu\text{g/ml}$ BFA, indicating that inhibition of *Acheta* Vg secretion occurred at approximately the same BFA concentrations (results not shown) as in *Carausius*.

Time required for BFA to take action

To determine the minimum time lag required for BFA action, fat body was pre-incubated 2 hr in 10 μCi ^{35}S -met in Grace's Insect Medium to label protein throughout the entire secretory pathway. The tissue was then rinsed, and transferred to culture medium lacking ^{35}S -met but containing 50 $\mu\text{g/ml}$ BFA. Control fat body samples were incubated without BFA. Samples taken at intervals of 0, 5, 10, 15, 20, 30, and 60 min after transfer to the BFA-containing medium were processed for SDS-PAGE/fluorography. Labeled pre-Vg and Vg polypeptides were present in the fat body under both culture conditions. Small amounts of labeled Vg polypeptides were present in the BFA-containing incubation medium at all time intervals (results not shown), but no increase in the intensity of labeling of any Vg polypeptide was seen in incubation media after any of the time intervals. The control (no BFA) incubation medium showed 5 heavily labeled Vg polypeptide bands present by 60 min. These observations suggest that the BFA-mediated block to secretion occurs rapidly, possibly in less than 5 min. The small amount of labeled polypeptides present in the 5-60 min incubation media probably represents polypeptides that were labeled during the pre-incubation period and had already passed through the Golgi complex by the time BFA was introduced into the medium.

SUMMARY AND DISCUSSION

In this study, the first to document the effects of BFA on insect tissue, we report altered Vg secretion by *C. morosus* fat body upon *in vitro* exposure to BFA.

In vitro pulse labeling of fat body protein with ^{35}S -met confirmed earlier *in vivo* work by Giorgi and Macchi (1980) which showed the fat body to be a major site of Vg synthesis, confirmed that the five major Vg polypeptides are synthesized and secreted by the fat body, and indicated that approximately one hour is required for Vg to traverse the fat body secretory pathway. In our study, two high molecular weight fat body polypeptides (pre-Vgs) were shown to share epitopes with two *C. morosus* Vg polypeptides, using Mabs raised against *Carausius* Vt. The decreased labeling of fat body pre-Vg and concomitant increased labeling of secreted Vg polypeptide over time seen in the pulse labeling of fat body further supports the view that the two groups of polypeptides (pre-Vgs and Vgs) have a precursor-product relationship.

A 20 $\mu\text{g/ml}$ BFA concentration completely inhibited secretion of labeled Vg polypeptides by *C. morosus* fat body; concentrations of 5 and 10 $\mu\text{g/ml}$ appeared to partially inhibit secretion. These same BFA concentrations produced similar effects on *Acheta domesticus* fat body Vg secretion in a preliminary experiment (unpublished). We found inhibitory BFA concentrations for *Carausius* to be slightly higher than inhibitory concentrations reported for vertebrate cells (Lippincott-Schwartz *et. al.*, 1991b; Kömhoff *et. al.*, 1994); however, most studies have used cultured cells rather than tissue pieces. Monolayers of cells may react more rapidly and to lower BFA concentrations than tissue pieces such as were used in our study. The higher BFA concentrations required to inhibit secretion in *Carausius* may also reflect differences in cellular sensitivity or in available BFA binding sites. BFA at 10 $\mu\text{g/ml}$, the concentration found to partially inhibit Vg secretion in our study, has been shown to inhibit secretion of one acid phosphatase (AP) isoform in tobacco protoplasts (Kaneko *et. al.*, 1996), without inhibiting the secretion of another AP isoform.

BFA action on *Carausius* fat body appeared rapid, since secretion was unchanged 5 min after exposure to BFA. Additionally, the failure of fat body to accumulate labeled Vg polypeptides in the absence of Vg secretion (20 $\mu\text{g/ml}$) indicates that proteolytic processing of pre-Vg to Vg may be affected by BFA as well as secretion.

Preliminary ultrastructure studies (unpublished) in our laboratory of fat body exposed to 10 $\mu\text{g/ml}$ BFA revealed ultrastructural changes in the Golgi region of fat body cells. Although *Carausius* fat body cell cytoplasm is filled with large lipid droplets which makes observations of cytoplasmic morphology more difficult, numerous stacked, flattened cisternae, typical of Golgi morphology, were observed in untreated fat body, while no intact Golgi stacks were seen in the BFA-treated cells. Rather, numerous highly vesiculated areas of apparently disorganized membrane were present in the perinuclear regions of treated tissue. In addition, the ER in many of the BFA-treated cells appeared markedly dilated. This disorganization of the Golgi area and dilation of ER correlates with the findings of others in which altered ER/Golgi morphology occurred in BFA-treated cells (Misumi *et. al.*, 1986; Fujiwara *et. al.*, 1988; Ulmer and Palade, 1991), and suggests that morphological changes in the ER and Golgi complex occur in the presence of continued (although diminished) secretion.

The existence of Golgi-independent secretory pathways in mammalian cell systems has been suggested by studies demonstrating protein secretion which is insensitive to BFA (Muesch *et. al.*, 1990; Sato *et. al.*, 1993; Kaneko *et. al.*, 1996). However, our documentation of the inhibitory action of BFA on insect Vg secretion provides evidence that fat body Vg is secreted via the classical Golgi pathway.

We have found that BFA affects protein secretion by *Carausius* fat body cells in a manner similar to that reported for cultured mammalian cells (Takatsuki and Tamura, 1985; Misumi *et. al.*, 1986; Fujiwara *et. al.*, 1988; Lippincott-Schwartz *et. al.*, 1989, 1991a, 1991b; Ulmer and Palade, 1991a, 1991b). Although higher effective BFA concentrations were required than for several other cell types, the ability of BFA to inhibit Vg secretion in

Carausius fat body indicates that this agent may be useful for studying intracellular processing of Vg and other proteins in insect cells. Most Vgs which have been studied have been shown to be phosphorylated, glycosylated, lipidated (Kunkel and Nordin, 1985), and sulfated (Bauerle and Huttner, 1985; Dhadialla and Raikhel, 1990), although the specific biological roles for the carbohydrate, lipid, phosphate, and sulfate moieties that are added to the Vg polypeptide backbone are unknown. Whether or not BFA influences post-translational modification of Vg within fat body is not addressed by this study. Evidence suggests that BFA action is more generalized than previously thought in that it also causes phenotypic changes in endosomes, lysosomes, and the *trans*-Golgi network (TGN) (Lippincott-Schwartz *et. al.*, 1991a). It would not be surprising if post-translational modification of Vg polypeptides were altered in the presence of BFA because of the redistribution and possible recompartmentalization of Golgi enzymes which might isolate these enzymes from their potential substrates.

The insect fat body provides a good model for studying the secretory pathway in invertebrates. Examination of this system offers opportunities to examine the sequential events associated with protein synthesis, processing, post-translational modification, sorting, and secretion. Elucidation of details of post-translational events may provide information on protein function, insect reproductive physiology, evolution of Vgs, and homologies or phylogenetic relationships between groups or species.

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THE CAHABA LILY: ITS DISTRIBUTION AND STATUS IN ALABAMA

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The Cahaba or shoals spiderlily, *Hymenocallis coronaria*, is an emergent aquatic plant native to the major river systems of Alabama, Georgia and South Carolina. Its very specialized habitat demands--swift-flowing water over rocks, with an open canopy--restrict it to shoal areas of broad streams.

Like other spiderlilies, the Cahaba lily is noted for the striking beauty of its 3-inch broad, white flowers (Fig. 1). The six perianth parts surround a membranous corona, which connects the lower portions of the stamens (Fig. 2). Its scientific name, translated as "beautiful crown-like membrane," accurately depicts these characteristics.

Ever since its discovery by Western scientists 200 years ago, the Cahaba lily has been considered to be quite rare. It has been listed as "endangered" by Alabama botanists (Freeman *et al.*, 1979; Thomas, 1976), with similar status granted by heritage programs in Georgia and South Carolina. It is currently under review by the U. S. Fish and Wildlife Service (FWS) as a possible endangered or threatened species at the federal level.

My formal work with the Cahaba lily began in 1989, when I obtained a travel grant from FWS to study the species in Alabama and Georgia; later grants, from FWS and Samford University, allowed me to expand my studies into South Carolina. Five aspects were examined: distribution, habitat requirements, reproductive biology, taxonomic status, and possible threats. I will use these aspects as the major headings for this paper.

DISTRIBUTION

The Cahaba lily is native only to Alabama, Georgia and South Carolina. A county dot-map (Fig. 3) shows that the species occurs in a broad band across the southeastern United States, with a significant gap in mid-Georgia. Lilies are known from most of the major river systems of the Southeast, with populations occurring at or above the Fall Line. These systems include (from west to east) the Black Warrior, Cahaba, Coosa, Tallapoosa, Chattahoochee, Flint, Savannah, Congaree, and Catawba. Although absent from the Ocmulgee and Oconee systems, the species most likely occurred there prior to the building of locks and dams.

Cahaba Lily



Figure 1. Close-up of Cahaba lily flower, front view.



Figure 2. Close-up of Cahaba lily flower, side view.

Cahaba Lily

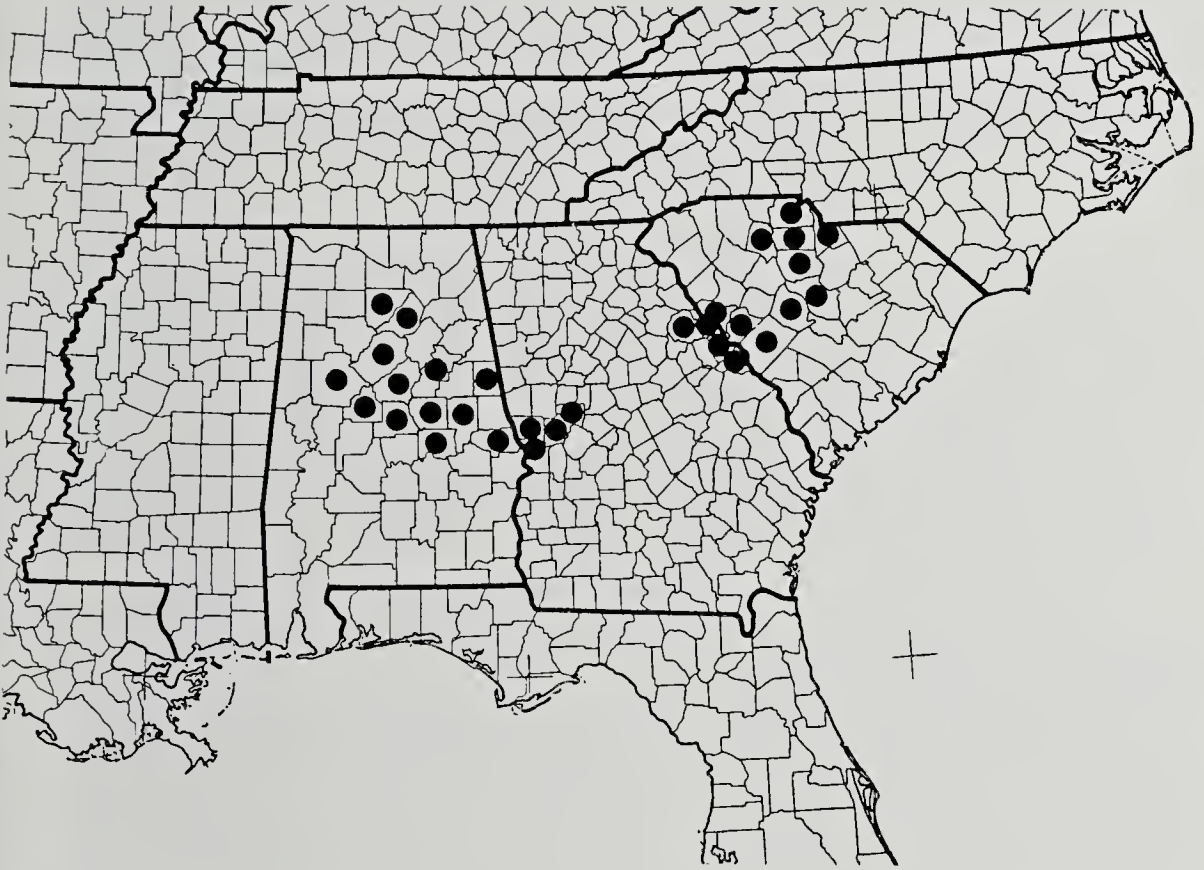


Figure 3. County dot-map distribution of *Hymenocallis coronaria*.

Currently, 50 populations of Cahaba lilies are known--30 in Alabama, 10 in Georgia, and 10 in South Carolina. (See Fig. 4 for Alabama populations.) Populations range from thousands of plants spread across the shoals of a major stream, as at Hargrove Shoals on the Cahaba, to just a few plants tucked into the rocks of a tributary. Usually, the lilies are found in scattered clumps across the shoals and intermixed with other species (especially *Justicia americana*), but in the Little Cahaba River below Six Mile Creek they occur in a single concentrated mass.

Cahaba lilies have been studied by Alabama scientists for the past century. The first known specimen was collected by the State Geologist, Eugene Allen Smith, from the Black Warrior River near Tuscaloosa, apparently during the late 1870s. (The undated specimen is housed in the Mohr Herbarium, University of Alabama.) Charles Mohr, utilizing Smith's collection in compiling his monumental *Plant Life of Alabama* (1901), listed "Wet rocks in Warrior River" as the only state locality known at that time.

Roland Harper (1914) analyzed the vegetation at Squaw Shoals, about 26 river-miles above Tuscaloosa, in an effort to document that vegetation before it was destroyed by the completion of Lock 17 (now part of Bankhead Lock & Dam). His visit took place in early June, when *Hymenocallis coronaria* was in full bloom: "From a distance its numerous large white flowers gave somewhat the appearance of a thin layer of snow." Harper went on to state that the Smith-Mohr locality had been "drowned out" several years before, but that a new locality had recently been discovered "in [Buck Creek] near Helena, Shelby County, where it seems to be in no immediate danger of extermination." The Helena population (cover photograph) still exists, and so represents the longest continuously monitored population in Alabama.

With the completion of Lock 17, the lilies were erased from the main channel of the Black Warrior. They are known, however, from both the Mulberry and Locust forks, and probably occur in other tributaries as well.

In Alabama, the lily takes its common name from the Cahaba River, and is best associated with that stream. But it is not known exactly when scientists first noticed the species in the Cahaba drainage. Smith conducted field work in this area on numerous occasions, and was the discoverer and first collector of *Croton alabamensis* on the bluffs above Pratt's Ferry. Yet his field notes, housed in the library of the Geological Survey of Alabama, contain no references to Cahaba populations of lilies. Photographs (negs. 5-1969 and 5-1970) in the archives of the Alabama State Museum of Natural History, taken during the 1930s, constitute the earliest known documentation of lily populations in the Cahaba.

More populations are known from the Cahaba than from any other river system in the state, simply because the Cahaba remains essentially dam-free. Pockets of plants are found in the main channel above Grants Mill Road east of Birmingham, and occur at intervals downstream 83 river-miles to the Falls of the Cahaba near Centreville. As previously noted, they are also known from a tributary, Buck Creek, and from the Little Cahaba River.

Cahaba Lily

In contrast, few populations remain in the main channel of the much-altered Coosa; in fact, the only recently documented populations consist of scattered clumps below Jordan Dam. (For a detailed discussion of the damming and modification of central Alabama's rivers, see Jackson [1995]). However, healthy populations remain in Hatchet Creek and other tributaries (Chestnut, Choccolocco, Weogufka, and Yellowleaf), and it is suspected that additional Coosa populations await discovery.

The Tallapoosa has also been altered, but not to the same extent as the Coosa. Most of the main channel lily populations are clustered around Horseshoe Bend, as at Irwin Shoals and Griffin Shoals; plants are also known from the major tributary in this area, Hillabee Creek. A small population is found upstream at Price Island below R. L. Harris Reservoir (see "Possible Threats"), and an outlying population remains in Sougahatchee Creek near Loachapoka.

HABITAT REQUIREMENTS

As previously stated, *Hymenocallis coronaria* is indigenous to shoal areas of fairly broad streams. The shoals contain rock crevices in which lily seeds and bulbs may lodge, keeping the plants stable in the turbulent water, and may be carved from a number of geological formations. In the Cahaba drainage, the streams cut through the Pottsville Formation of sandstone with interbedded shale and siltstone; oftentimes the flat, foliated rocks are tilted upstream, creating protected pockets immediately behind. The extensive population at Jackson Shoals on Choccolocco Creek (Coosa drainage) is underlain by dolomitic limestone with shale and mudstone; shoals in the Horseshoe Bend area (Tallapoosa drainage) are formed from metamorphic rocks, mainly muscovite and schist.

In addition to rock crevices, Cahaba lilies demand the full sunlight provided by an open canopy; they are thus found on the open, broad shoals of large streams. Swift-flowing water is also a habitat requirement, most likely as a means of providing large amounts of oxygen to the roots. The swift-flowing water also prevents sediment from settling around the plants and allowing competitors to take root. Two Cahaba River populations--at Booth Ford and near Old Looney Mill Road--are known to be declining in numbers; in both situations, water is being diverted around the lilies, sediment is accumulating, and small islands are forming.

REPRODUCTIVE BIOLOGY

In Alabama, individual plants of *Hymenocallis coronaria* emerge in mid-April, following the spring floods. Flower stalks develop after the leaves are fully emerged, and each stalk is capped by 6-9 buds within protective bracts. Flowering commences in mid-May, reaching a peak in late May and early June; sporadic flowering continues until late June.

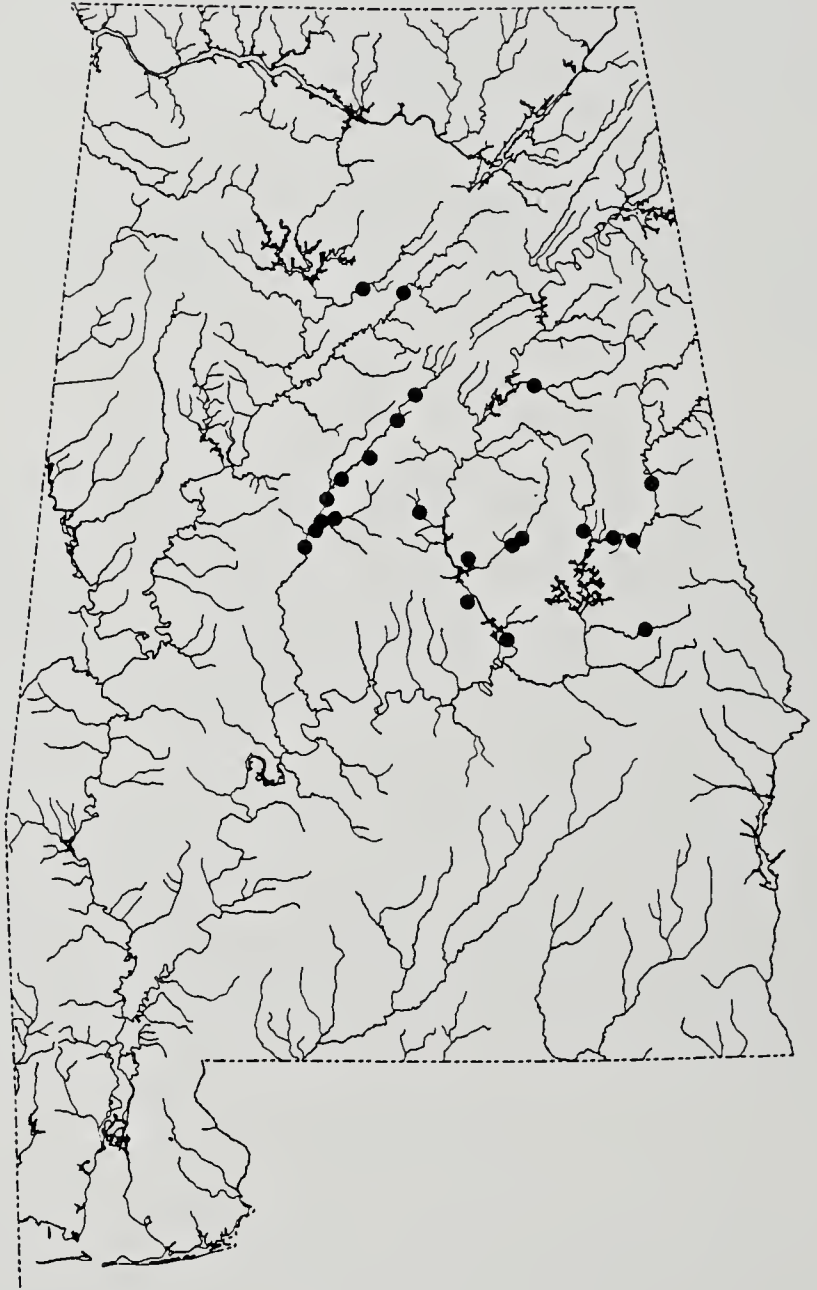


Figure 4. Alabama populations of *Hymenocallis coronaria*.

Cahaba Lily

The development of individual flower buds on a stalk takes place in a set sequence, such that each day a fresh flower opens and is available to pollinators. Flowers open in the early evening, which is also the time when they are most fragrant. To date, two pollinators have been captured while visiting the flowers--the plebeian sphinx moth (*Paratreia plebeja*) and the pipe-vine swallowtail (*Battus philenor*). While these and other creatures certainly pollinate the plants, it is doubtful that cross-pollination alone accounts for the thousands of seeds produced each year. Apomixis, or the production of seeds without pollination or fertilization, is most likely at work, and experiments are currently being conducted to determine what portion of the seeds are produced asexually.

Once pollination and fertilization have occurred, the ovaries gradually expand until they split; the oblong, olive-sized seeds complete their development outside the ovary wall. The seeds remain green and photosynthetic until maturity, at which point they drop to the stream bottom and are swept into rock crevices. Germination follows in about a week (at least in laboratory environments), resulting in small bulbs with strap-like leaves.

TAXONOMIC STATUS

Presence of the shoals spiderlily was noted by Bartram in 1773 at the "cataracts of Augusta" on the Savannah River. In his opinion, "nothing in vegetable nature was more pleasing than the odoriferous *Pancratium fluitans*, which almost alone possesses the little rocky islets which just appear above the water." Although Bartram clearly referred to this species, his name "*Pancratium fluitans*" was unaccompanied by a description, and so must be considered as a *nomen nudum* (see F. Harper, 1958; Merrill, 1945). The species was later described from the same area by LeConte (1836), who called it *Pancratium coronarium*. Kunth (1850) then transferred this species to the genus *Hymenocallis*; its name thus became *Hymenocallis coronaria* (LeConte) Kunth.

The genus *Hymenocallis* is well known as a "problem" genus that takes even professional taxonomists to task. In fact, Godfrey & Wooten (1979), in the most recent regional work, cited "a relative paucity of herbarium material" and "an equal dearth of critical information" in deciding to offer no treatment at the species level. Treatments of *Hymenocallis* have traditionally been based on floral characteristics, especially those of the corona or staminal cup. Due to similarities in these characteristics, *H. coronaria* has often been lumped with other species--Fernald & Schubert (1948) treated it as *H. caroliniana*; Sealy (1954) included it as a variant of *H. rotata*; and Radford *et al.* (1968) listed it under *H. crassifolia*. In central Alabama, the Cahaba lily is most often confused with its only sympatric relative, the swamp spiderlily, *H. occidentalis*. The following characteristics,

however, show *H. coronaria* to clearly be an entity distinct from the latter:

- 1) plants of rocky shoals and open canopies (rather than swamplands and forests with closed canopies)
- 2) plants flowering May-June (rather than August-September)
- 3) leaves erect, long (70-90 cm), narrow (3-4 cm), gradually tapered to a point (rather than lax, short [50-60 cm], wide [4-6 cm], abruptly drawn to a point)
- 4) seeds oblong (2-4.5 cm long), dark green, sinking in water (rather than spherical [1.5-2 cm round], light green, and floating).

Thus, by using "nontraditional" characters--habitat, flowering time, leaf morphology, and seed morphology--*H. coronaria* can be easily distinguished.

POSSIBLE THREATS

A number of human activities threaten the survival of *Hymenocallis coronaria*; in some cases, these activities have already led to the extirpation of populations. Historically, its major threat has been the damming of streams for navigation, power generation, and other uses. Since this species demands rocky shoals for its habitat, and since shoals pose an obstacle to efficient navigation, many of its best habitats have already been eliminated. The case of Squaw Shoals on the Black Warrior River has been well documented by Roland Harper (1914), and a Savannah River population now lies below Clarks Hill Lake. Damming of the Flint River has often been considered for various purposes, and--depending on the location of the dam--such activities could endanger populations in that river system. The proposed dam on the Locust Fork of the Black Warrior River would eliminate the species from that stream.

Even if lily populations are spared extirpation by dam-building, they can still be severely impacted. A case in point involves a Tallapoosa River population at the north end of Price Island. Here the plants are subjected to daily flooding during the summer months, due to the release of water from a hydroelectric plant. The pollen is thus flushed from the flowers, making sexual reproduction impossible, and the continued existence of this population is much in doubt.

A second major threat--and one that is rapidly gaining in importance--is increased sediment load from logging, mining and construction projects. *Hymenocallis coronaria* demands swift-flowing water, so that oxygen is delivered to the roots and bulbs and sediment buildup is minimized. If, however, sedimentation occurs, small "islands" form on the shoals, and competing species are able to take hold. This phenomenon--sedimentation followed by competition--seems to be the major problem facing populations that are currently doing poorly. For the survival of this species, then, regulations regarding the maintenance of buffer zones along streams must be strictly followed and enforced.

Cahaba Lily

A more recent threat--although currently restricted to Bibb County populations--is the proposed dumping of salty wastewater from coalbed methane operations. While no factual data are available concerning the effect of salt water on *Hymenocallis coronaria*, it is generally agreed that freshwater organisms, of any kind, do poorly under such conditions. And while it is true that natural river flow would flush the salt away, a combination of salt water AND sedimentation could act to concentrate the salt around plant roots. Until it is disproven, salt water discharge must be considered to pose a serious threat to the survival of *H. coronaria*.

Finally, the poaching of bulbs for sale to wildflower enthusiasts must be considered to be a threat to the survival of this species. Several documented cases occur involving the ripping of lily bulbs from the rocky substrate in the main Cahaba River channel and Hatchet Creek. A Tuscaloosa County nurseryman has admitted such activities, passing the bulbs on to Birmingham area garden shops and nurseries (Kipp, 1991).

CONCLUSIONS

While appearing quite delicate, the Cahaba lily is well-adapted to survive in a most rigorous habitat. Due to human activities during the past 200 years, however, the total area available to the species has been greatly reduced, while the remaining is being rapidly degraded. The species, then, presents a classic case of endangerment due to habitat loss.

Because of its obvious beauty and dwindling habitat, the Cahaba lily has become a symbol for the unharnessed, unpolluted, free-flowing streams of central Alabama (Fig. 5). The Cahaba River Society uses the lily extensively in its promotional materials, and innumerable artists and photographers have tried to capture its beauty. Since 1990, the town of West Blocton has held a Cahaba Lily Festival each May, complete with the crowning of a Cahaba Lily Queen and the opportunity to walk among the lilies. Truly, few plant species are so recognized and appreciated by the general public!

While the lily is currently afforded no protection under federal, state or local laws, it is time to do so--especially with increased threats due to pollution and poaching. With proper protection, this symbol should survive.

ACKNOWLEDGMENTS

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Figure 5. Cahaba lilies at Hargrove Shoals, Bibb County.

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GROWTH AND SURVIVAL OF PRAWN LARVAE,
MACROBRACHIUM ROSENBERGII, FED *ARTEMIA* NAUPLII
FROM DIFFERENT GEOGRAPHICAL LOCATIONS

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ABSTRACT

Growth and survival were examined in Malaysian freshwater prawn larvae, *Macrobrachium rosenbergii*, fed either Colombian (CO) or San Francisco Bay (SFB) strains of *Artemia*. After 40 days of culture, 40% of the prawn larvae fed SFB *Artemia* survived, while 62.5% of the larvae fed CO *Artemia* survived. Approximately 25 and 90% of these, respectively, developed into post-larvae. Growth rates for larvae fed the SFB *Artemia* were relatively slow, with first post-larvae appearing at day 28 of culture. Growth rates for the larvae fed the CO *Artemia* were rapid, with first post-larvae appearing at day 20 of culture. *Artemia* strains from different geographical areas differ typically in biochemical composition, particularly fatty-acid content. The results of this study demonstrated the diverse abilities of *Artemia* strains from different geographical areas in maintaining the growth and survival of *M. rosenbergii* larvae in intensive culture. Although the content of protein and carbohydrate differs slightly in these *Artemia* strains, we hypothesize that our observed differences in growth rates and survival for *M. rosenbergii* larvae were due to differences in ω -3 fatty acid composition of their respective diets.

INTRODUCTION

Several species of freshwater prawns inhabit the rivers and streams of South America and Asia. For centuries, prawn have been exploited economically by artisanal fishing, however, in the last quarter century, natural harvests have been declining steadily due to deteriorating environmental conditions. (Baisre and Castell, 1992). In the 1970's, researchers began to examine the potential of commercially culturing several of the larger size species (for review, see Valenti, 1993). To date, the giant Malaysian prawn, *Macrobrachium rosenbergii*, has been studied more extensively than any other species, and is, at present, the most commercially important culture species worldwide (Malecha, 1988).

The success of intensively culturing freshwater prawn has been highly dependent on the development of cost-effective culture methods. Previous studies have determined the environmental conditions (water hardness, pH, salinity, dissolved oxygen, etc.) which elicit normal growth and development of prawn larvae (for review, see Malecha, 1983b). The type of diet, however, required to maintain normal growth and survival of large numbers of larval prawn in intensive cultures has not been investigated thoroughly. The standard larval diet culturists will use in commercial hatcheries can be quite variable. Because of this variability in diet, survival rates from hatch to hatch can be as high as 90% or as low as 10% (Malecha, 1983b). Furthermore, under optimal conditions, prawn larvae normally develop into post-larvae in about 24 days. In nutritionally stressed prawn larvae, this time can be increased to greater than 40 days (Corbin et al., 1983). The cultivation of the larval forms of the Malaysian freshwater prawn, thus, remains problematic, even when using "standard" diets commonly used in commercial hatcheries.

Little is known about the nutritional requirements of *Macrobrachium rosenbergii* larvae and the feeds and feeding practices utilized are the result of rational observation and empirical testing (Corbin et al., 1983). Some of the first attempts at intensively culturing prawn larvae were unsuccessful using animal based food sources such as live zooplankton, chopped fish flesh, or combinations of live and chopped animal matter (Ling, 1969b). Several attempts were also unsuccessful using formulated rations designed specifically for shrimp and crab larvae (Ling, 1969b). Fujimura (1966) was among the first to intensively culture *M. rosenbergii* larvae successfully through all of the larval stages. Using diets comprising of newly hatched brine shrimp nauplii (*Artemia* spp.), Fujimura obtained prawn post-larvae in 24 days with survival rates near 50%. Today, culturists continue to utilize *Artemia* nauplii as the primary food constituent in prawn larval diets despite knowing fully the nutritional contribution they provide.

A review of the literature suggests that *Artemia* cysts from different geographical areas vary in their ability to maintain crustacean larval growth and survival (for review, see Beck et al., 1980). For example, differential growth and survival are observed when larvae from the crabs *Rhithropanopeus harrisii* and *Cancer irroratus* are cultured using *Artemia* nauplii collected from different geographical areas (Beck et al., 1980). In particular, those Brachyuran larvae fed *Artemia* nauplii of South American (Brazil) or Italian origin demonstrated significantly better growth and survival than those fed *Artemia* of California (San Pablo Bay) or Utah (Great Salt Lake) origin. Fujita (1980) examined the relationship between the dietary value and biochemical composition of *Artemia* from these different geographical areas. Many differences in the inherent biochemical composition of the *Artemia* strains were observed, particularly with respect to ω -3 fatty acid content. Fujita (1980) hypothesized that the cause of high mortalities and growth deficiencies in many cultured fish and crustacean larval cultures were due to deficiencies in essential fatty acids in the diet. Similar growth deficiencies and high mortality rates have been reported for cultures of prawn larvae when fed *Artemia* from different commercial sources (New, 1990). No investigations,

however, have examined the possible correlation between successful and unsuccessful prawn larval cultures and the geographical source of *Artemia* used as a food source.

MATERIALS AND METHOD

Ovigerous female prawns were obtained from the laboratory of Dr. Lou D'Abramo at Mississippi State University and disinfected by rinsing in an aquarium containing a mild formalin solution (200 ppm) for approximately 15 minutes. The females were then transferred to a large recirculating artificial sea water system held at $27 \pm 1^\circ\text{C}$ and 12 ppt salinity (Fujimura, 1966). Females with ripening eggs, indicated by dark brown eyespots, were removed from the larger holding system and placed into smaller holding tanks until hatching occurred. After hatching, larvae were collected and dipped in a mild formalin solution (50 ppm) for approximately 15 minutes to reduce the risk of infection.

Larvae were cultured in artificial sea water made with Tropic Main sea salts and deionized water. Each of the two closed-cycle systems used had a capacity of approximately 200 liters which was recirculated through an associated external biofilter containing nitrifying bacteria cultures (*Nitrosomonas* and *Nitrobacter* spp.) to remove ammonia and associated waste compounds (Fig 1A). The biofilters were of simple design, consisting of baffles to facilitate flow over and under oyster hatch that had been seeded with Fritz-zyme™ Biological Conditioner². The total area of biofiltration surfaces in each biofilter was approximately 0.012m^3 . Water recirculation through the biofilters was facilitated by air lifters. Dissolved oxygen, ammonia, nitrite, pH, and temperature were recorded daily for each chamber using water quality test reagents from Fritz Aquaculture. Ammonia levels in either system were maintained below 1 ppm, nitrate levels below 0.5, and oxygen levels between 6.6 and 6.8 ppm.

Larvae from a single hatch were divided into two groups ($N \sim 4,000$ larvae/chamber) and placed in our closed-cycle systems at a salinity of 12 ppt and a temperature range of $27 \pm 1^\circ\text{C}$ (Malecha, 1983b). This stocking density has previously been shown to be below the limit of stress where density-dependent mortality occurs for this species (for review, see Malecha, 1983b). Only larvae which responded positively to light were selected for the experiments (Roberts, 1972). Larvae were fed diets of *Artemia* nauplii hatched from cysts collected from either San Francisco Bay³ (SFB) or Colombia⁴(CO). Prior biochemical analysis of these strains of *Artemia* has demonstrated that SFB and CO *Artemia*

have differential ω -3 fatty acids contents (Table 1, Watanabe et al., 1978b). *Artemia* titers were maintained at 10-20/ml in each larval chamber throughout the duration of the experiment.

²Fritz Aquaculture, Division of Fritz Industries Inc., P.O. Drawer 17040, Dallas TX 75217- 1-800-955-1323

³San Francisco Bay Brand, Inc., P.O. Box 485, Newark, CA 94560, Lot 1879, (415) 792-7200

⁴Aquarium Products, Inc., 180L Penrod Ct., Glen Burnie, MD 21061, (301) 761-2100

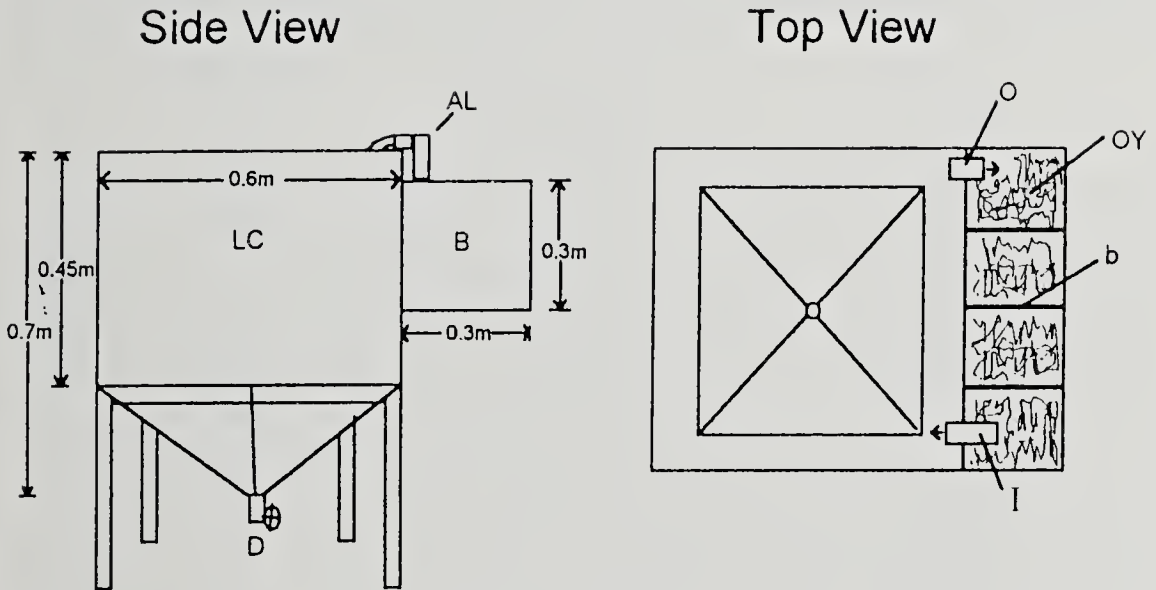


Figure 1. Side and top views of closed-cycle system used to rear developing *Macrobrachium rosenbergii* larvae. Side view indicates overall measurements of the systems. All systems were designed by Dr. George Cline (modified from hatchery designed larval-rearing chambers) and comprised of a 200 l rearing tank with an associated biofilter. The rearing tank was square shaped and angled at the bottom to allow easy chamber cleaning. Side view: AL = air lifter, B = biofilter, LC = larval chamber, D = drain. Top view: b = baffle, I = input from biofilter, O = output from larval chamber, OY = oyster hatch.

Table I²Fatty acid composition of *Artemia* from different geographical areas (area%)

<u>Fatty acid</u>	<u>San Francisco Bay</u>	<u>Colombia</u>
14:0	0.9	0.5
16:0	9.5	7.9
16:1 ω 7	12.0	5.8
16:2		
17:0	0.9	1.9
18:0	6.8	5.9
18:1 ω 9	36.1	26.3
18:2 ω 6	3.4	5.2
18:3 ω 3	10.3	21.0
18:4 ω 3		
20:0	1.2	6.5
20:3 ω 3		
20:4 ω 6	2.7	0.6
20:4 ω 3	0.4	0.7
20:5 ω 3	9.5	0.3

²Table taken from Watanabe et al. (1978b).

Growth rates and developmental stage were assessed daily by microscopic examination of at least 250 larvae from each of the culture chambers. The general conditions of the larvae (eating habits, activity, and coloration) were also noted and developing body structures were used as indicators of the developmental stage of the larvae (New and Singholka, 1985). Daily survival was estimated by subtracting the number of dead larvae found in the wash from the daily chamber cleaning from the total number of live estimated on the previous day. Survival was also estimated from total live counts of five 1 liter grab samples. When post-larvae appeared in a culture, they were removed and placed in separate holding containers to reduce cannibalism of other larvae.

RESULTS

The growth rates and survival of *Macrobrachium rosenbergii* larvae cultured in our closed-cycle systems are presented in Figure 2. After 40 days of culture, 40% survival was observed in larvae reared on SFB *Artemia* (Fig. 2A). A small percentage of these larvae, approximately 25%, developed into post-larvae. Larval growth was also slow with first post-larvae appearing around day 28 of culture. Pigmentation abnormalities, unusual light-blue to brown coloration patterns on the carapace, were noted in prawn larvae fed SFB *Artemia*. This situation has similarly been noted by culturists in poorly developing, nutritionally deprived *M. rosenbergii* larvae (New and Singholka, 1985).

Growth rates and survival of prawn larvae cultured on CO *Artemia* were much different. After 40 days of culture, 62.5% survival was observed. Approximately 90% of these had developed into post-larvae (Fig. 2B). Growth rates for this group were also faster with post-larval stages appearing at day 20 of culture. Larvae in this group were very active feeders and appeared healthy, as noted by their orange-brown pigmentation (New and Singholka, 1985). Post-larvae were also very active feeders and had to be removed immediately from the rearing chambers to avoid cannibalism of conspecifics.

DISCUSSION

The successful aquaculture of the freshwater prawn, *Macrobrachium rosenbergii*, involves careful consideration of many parameters including water quality, stocking density, diet, and disease. In addition, the size of the spawn and health of the larvae can be effected by the genetics and health of the broodstock. For example Malecha (1977) reported that for one group of prawns where brood females mated randomly with males, 10% of the ovigerous females produced over 90% of the viable larvae. Studies on the effects of diet on the development and survival of any species, therefore, must use larvae from the same hatch or as few hatches as possible. It is for these reasons that we employed the use of selected hatches of larvae for our experiments. Due to the limited availability of selected stocks of prawn, however, we were unable to perform multiple replicates of our experiments. Nonetheless, the data reported here do demonstrate the diverse ability of *Artemia* strains from different geographical areas to maintain the growth and survival of prawn larvae when used as a sole food source.

Prawn Larvae

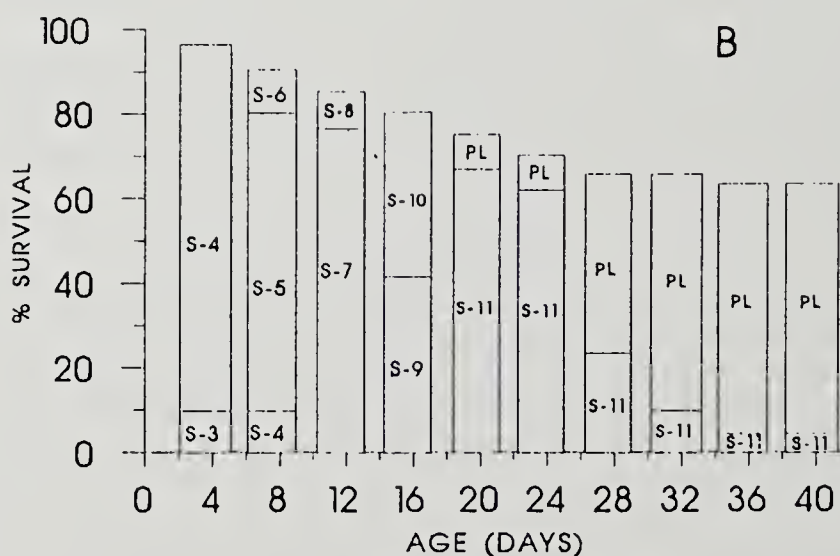
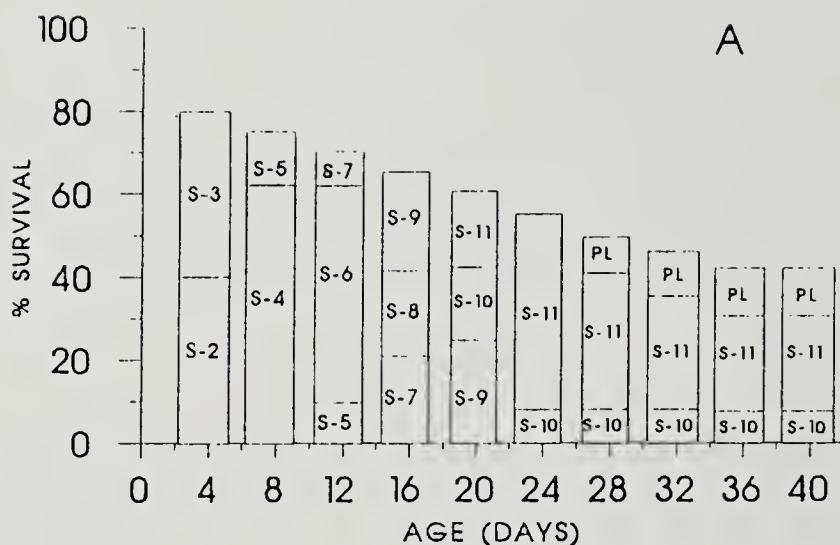


Figure 2. Growth and survival of *M. rosenbergii* larvae fed *Artemia* of San Francisco Bay (A) or Colombian (B) origin. Stage of growth is represented as S-2 (stage 2), S-3 (stage 3), etc. PL = post-larvae.

In the present study, differential development rates and survival were observed in *Macrobrachium rosenbergii* larvae fed either SFB or CO *Artemia*. In total, over 2200 prawn post-larvae were produced when using CO *Artemia* as a food source. The survival and growth of prawn larvae observed here are similar to previous data obtained from hatches reared in our culture chambers when using SFB *Artemia* as a sole food source. Prawn larval survival ranges typically from 32.37-46.29% (95% CI) with post-larvae appearing between days 27 and 32. These results are also similar to those of Cline (unpublished) who has observed differential growth and survival in prawn larvae fed different strains of *Artemia* supplied from various commercial sources.

It has been suggested that the nutritional quality of an *Artemia* source might be expected to vary temporally as well as geographically. Generally, however, little temporal variation has been found in the biochemical composition of *Artemia* (Beck et al., 1980). Thus, the strains of *Artemia* used here probably have biochemical compositions similar to those reported by Fujita (1980). Short term changes in the diets of adult *Artemia* or seasonal changes in the environment where cysts are harvested could, however, have an impact on the quality of the resultant nauplii as a food source (Watanabe et al., 1978b). Thus, seasonal variation may be more important than annual differences when determining the nutritional quality of an *Artemia* source. It is for these reasons that careful consideration be taken before selecting any geographical strain of *Artemia* as a food source for developing prawn larvae.

The previous observations by Beck et al. (1980) would lead us to suggest that our observed differences in the growth and survival of *Macrobrachium rosenbergii* larvae were due to the inherent fatty acid composition of the *Artemia* used as a food source. The fatty acid content in the strains of *Artemia* used in this study were quite variable (see Table 1). Most noteworthy are the differences in the amounts of linolenic (18:3 ω 3) and eicosapentaenoic (20:5 ω 3) acids. Typically, SFB *Artemia* contain relatively high levels of eicosapentaenoic acid and low levels of linolenic acid, whereas CO *Artemia* contain relatively low levels of eicosapentaenoic acid and high levels of linolenic acid. Fujita et al. (1980) has determined that freshwater fish larvae demonstrate improved growth and survival when reared on *Artemia* rich in linolenic acid. Conversely, marine fish larvae demonstrate improved growth and survival when reared on *Artemia* rich in eicosapentaenoic acid. We suggest that prawn larvae may have a similar nutritional requirement for specific fatty acids in their diet.

Several investigators have determined that juvenile prawn have specific dietary fatty acid requirements (for review, see Corbin et al., 1983). Juvenile prawns, for instance, demonstrate enhanced development when specific fatty acids are supplemented in their diets (Sandifer and Joseph, 1976). No attempt, however, has been made to determine the fatty acid requirements of larval prawn. In this study we suggest that a diet which contains specific ω -3 fatty acids is necessary for optimal growth and survival of *Macrobrachium rosenbergii* larvae. Devresse et al. (1990) recommend levels of ω -3 fatty acids between 5.2 and 37.5 mg/g total body weight/day, however the specific type of ω -3 fatty acid required in prawn larvae diets have not been determined. Our data suggest that linolenic acid (18:3 ω 3) may be more essential in the diets of prawn larvae than other types of ω -3 fatty acids.

Prawn Larvae

Today, because of the increased knowledge that particular fatty acids can enhance the growth and survival of juvenile and larval prawn, culturists supplement *Artemia* cultures with "fatty acid boosters" before feeding them to prawn larval cultures. The type of fatty acids supplemented an *Artemia* diets can be quite variable and can again lead to large variances in the growth and survival of cultured prawn larvae. Nonetheless, this procedure has helped improve overall production somewhat in hatcheries. It is apparent, however, that further studies evaluating the specific dietary requirements of fatty acids, as well as other macromolecules, for *Macrobrachium rosenbergii* larvae are needed before vast improvements can be made at the industry level of production.

ACKNOWLEDGMENTS

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REACTION OF A CHLORONITRENO COMPLEX OF TUNGSTEN WITH
GALLIUM TRICHLORIDE: SYNTHESIS AND CHARACTERIZATION OF
 $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$

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ABSTRACT

Chloronitreno complex of tungsten, $\text{WCl}_4(\text{NCl})$, reacted with gallium trichloride to give a complex, $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$, with two chloride ligands bridging between tungsten and gallium. The formation of this complex was confirmed by the results of elemental analysis and IR-spectroscopy.

INTRODUCTION

Reactions of the chlorides of aluminum, gallium and indium with transition metal chlorides, in gas phase or condensed phase, have resulted in the formation of mixed metal halides in which ternary or bridging chloride ligands are observed (1). These complexes sometimes exist as molecules. As volatile gas complexes, they are useful for many types of chemical transport reactions (2). There are some complexes which also occur in the solid state in various forms. Few of these solids have been characterized by X-ray methods. Examples of compounds characterized by X-ray include CuAl_2Cl_8 (3), PdAl_2Cl_8 (4), CoAl_2Cl_8 (5), and NiAl_2Cl_8 (6). In all of these cases, the transition metal is bridged by four chloride ligands to two Al metal centers forming a tetrahedral geometry.

The reactions of transition metal pentachlorides such as NbCl_5 , TaCl_5 and UCl_5 , with AlCl_3 , have resulted in the formation of NbAlCl_8 (7), TaAlCl_8 (8) and UAlCl_8 (9), respectively. The transition metals in these complexes are bridged by two chloride ligands to Al, resulting in octahedral geometries around them. The structures of these compounds were studied by vibrational and mass spectroscopy methods and, in the case of NbAlCl_8 , by X-ray diffraction.

Chloronitreno complexes of some transition metals, $\text{MCl}_4(\text{NCl})$ ($\text{M} = \text{Mo}, \text{W}$), are similar in structure to the pentachlorides, MCl_5 . Therefore, it is possible to assume that these chloronitreno complexes will react with trihalides of Al, Ga and In, giving complexes with

bridging chlorides between the metal centers. So far there is no report on the reactivities of chloronitreno complexes with the above trihalides. A recent study by Abram and coworkers (10) on a nitrido complex of rhenium, which is similar to chloronitreno complexes, has demonstrated that GaCl_3 reacts with $[\text{ReNCl}_2(\text{PMe}_2\text{Ph})_3]$ to give a complex in which Ga and Re are bridged by nitride ligand. In this paper the reaction of a chloronitreno complex of tungsten, $\text{WCl}_4(\text{NCl})$, with GaCl_3 is reported and the properties of the product as well as its characterization are discussed. GaCl_3 is preferred in this reaction because of its solubility in organic solvents.

RESULTS AND DISCUSSION

Synthesis and properties

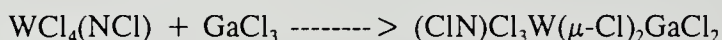
The reaction of equimolar amounts of $\text{WCl}_4(\text{NCl})$ and GaCl_3 in dichloromethane at -30°C for about an hour, and then at room temperature for three more days, resulted in a red-orange solution. Reducing the volume of the solution in vacuo to half the original volume and keeping it at 4°C for a week gave red-orange crystals in low yield. The low yield is due to high solubility of the product in the reaction solvent. Attempts to crystallize more of the product by using mixture of solvents such as dichloromethane/hexane or dichloromethane/ether gave only oily product having the same IR-spectrum as the isolated solid. The product was extremely sensitive to air and moisture. When exposed to the atmosphere, it immediately became colorless and lost its crystalline character. The product was very soluble in solvents such as acetonitrile and tetrahydrofuran, with a change in color to yellow. This is possibly due to coordination of these solvents to the metals breaking the chloride bridge between the metal centers (Fig. 1). The crystal was slightly soluble in diethyl ether and insoluble in hexane. No X-ray analysis could be performed due to low crystal quality.

Elemental analysis was used to characterize the product. The result obtained showed a good agreement between the calculated and experimental value for nitrogen. However, a difference of 1.71% for tungsten and 0.70% for chloride were observed. The possible reason for the poor agreement could be a mutual interference of the ions during analysis. Similar disagreements have been obtained for some compounds of this type which have even been characterized by X-ray method. Table 2 compares the analytical result of $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$ with compounds containing tungsten and chloride.

IR-Spectrum

The absorption bands of the IR-spectrum of the compound are listed in Table 1. The strong band at 1090 cm^{-1} corresponds to $\nu(\text{W}\equiv\text{N})$ vibrations. In comparison to $\text{WCl}_4(\text{NCl})$ (11), in which the $\nu(\text{W}\equiv\text{N}-\text{Cl})$ is observed at 1207 cm^{-1} , there is a shift of the $\nu(\text{W}\equiv\text{N})$ vibration to a lower wavenumber in the formed complex. This significant shift to a lower wavenumber, however, does not imply the formation of a bridging nitrido ligand of the form $\text{W}\equiv\text{N}-\text{GaCl}_3$ as reported by other workers (10). This is because in $\text{W}\equiv\text{N}-\text{Cl}$, the nitrogen is electron deficient due to formation of four bonds and therefore cannot act as a Lewis base to react with the Lewis acid, GaCl_3 . Moreover, if such a bridging complex had formed, the coupling of the vibrational frequencies between $\text{W}\equiv\text{N}$ and $\text{N}-\text{Ga}$ would have resulted in a shift to a higher wavenumber. The observed red shift may be due to the effect of the bridging chloride ligands, which compete with the chloronitreno ligand for the d-orbitals of tungsten. The very weak absorption band at around 528 cm^{-1} can be assigned to $\nu(\text{N}-\text{Cl})$ vibration. A band with about the same intensity at 530 cm^{-1} was assigned to $\nu(\text{N}-\text{Cl})$ in $\text{WCl}_4(\text{NCl})$ (11). In the region of $\text{M}-\text{Cl}$ vibrations, there are two strong bands at 420 cm^{-1} and 390 cm^{-1} which can be assigned to asymmetric and symmetric vibrations of $\text{Ga}-\text{Cl}$ (12-14). The strong bands at 360 cm^{-1} and 310 cm^{-1} are assigned to the terminal $\text{W}-\text{Cl}$ vibrations, and the medium band at 250 cm^{-1} is characteristic of vibrational frequency of bridging chloride ligands between two metal centers (12, 15).

The analytical results and IR-spectrum clearly suggest the following reaction gives the complex with structure shown in Fig. 1.



EXPERIMENTAL

Methods and Materials

All of the manipulations were carried out under an argon atmosphere using the Schlenk technique. The Schlenk tubes were thoroughly heated under vacuum to remove traces of moisture before use. All solvents were very well dried and degassed. Acetonitrile, dichloromethane and carbon tetrachloride were refluxed over P_2O_5 for three to four days and distilled under argon. Diethyl ether, tetrahydrofuran and hexane were distilled from a $\text{Na}/\text{benzophenone}$ mixture under argon. $\text{WCl}_4(\text{NCl})$ was synthesized by a literature method (16). GaCl_3 was purchased from Aldrich (99.99%) and used as received. IR spectrum was measured as a Nujol mull between cesium iodide plates on a Perkin-Elmer model 457 Grating Infrared Spectrometer ($4000 - 200\text{ cm}^{-1}$). Elemental analysis was performed in the Analytical Unit of Phillips University, Marburg, Germany.

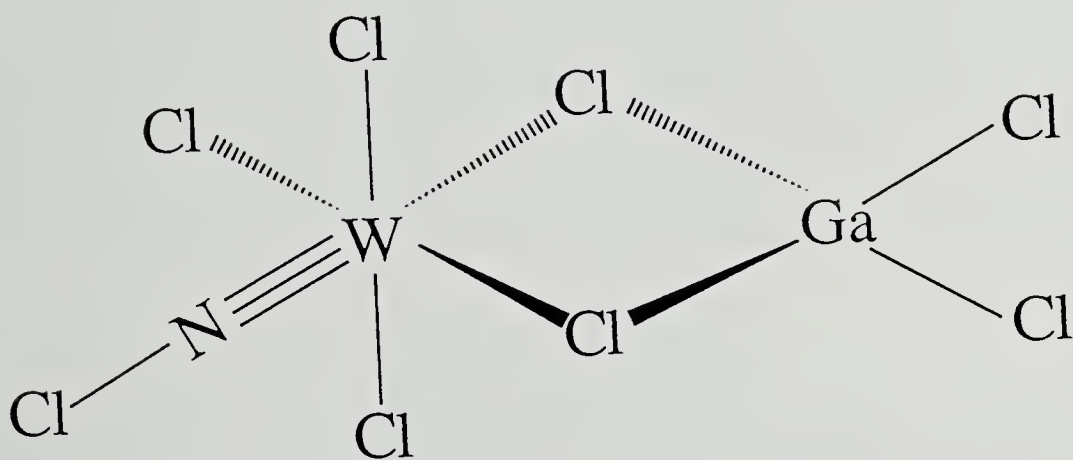


Fig. 1. Proposed structure for $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$

Table 1. IR-spectrum of $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$;

s = strong vs = very strong m = medium vw = very weak

cm^{-1}	Intensity	Assignment
1090	s	$\nu(\text{W} \equiv \text{N})$
528	vw	$\nu(\text{N-Cl})$
420	vs	$\nu_{\text{as}}(\text{Ga-Cl})$
390	vs	$\nu_{\text{s}}(\text{Ga-Cl})$
360	vs	$\nu_{\text{as}}(\text{W-Cl})$
310	s	$\nu_{\text{s}}(\text{W-Cl})$
250	m	$\nu(\text{W-Cl-Ga})$

Table 2. Analytical results of tungsten and chloride for some complexes

Compound	W, Calculated(found) %	Cl, Calculated(found) %	References
$\text{PPh}_4[\text{WCl}_4(\text{NCl})(\text{N}_3)]^{\text{a}}$	24.30(27.11)	23.36(23.56)	17
$[\text{WF}_2\text{Cl}_2(\text{N}_3\text{S}_2)]^-$	26.65(24.40)	10.28(11.07)	18
$[\text{WCl}_4(4\text{-Octin})^*(\text{CH}_3\text{CN})^{\text{a}}]$	not given	29.73(27.68)	19
$[\text{WCl}_4(\text{PhC} \equiv \text{CTe-n-C}_4\text{H}_9)]_2$	30.06(31.77)	23.19(24.71)	20
$(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$	33.35(35.06)	51.46(50.76)	This work

^a Are compounds characterized by X-ray method.

Synthesis of $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$

2.25 g (5.99 mmol) $\text{WCl}_4(\text{NCl})$ was suspended in 30 mL of dry dichloromethane and cooled to -30°C . 1.05 g (5.99 mmol) GaCl_3 , dissolved in 15 mL of the same solvent, was added to the above suspension while cold and stirred for one hour. The mixture was warmed to room temperature and stirred for three more days. The resulting red-orange solution was filtered and its volume reduced in vacuo by half and kept at 4°C for a week. Red-orange crystals were formed on the wall of the flask. These were removed from the wall of the flask by scratching with a glass rod, isolated by filtration and dried in vacuo. Yield: 1.25 g (37.8%) based on $\text{WCl}_4(\text{NCl})$. Elemental analysis: Calculated for $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$, N, 2.54; Cl, 51.46; W, 33.35; Found: N, 2.60; Cl, 50.76; W, 35.06

ACKNOWLEDGMENT

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REPORT ON THE GORGAS SCHOLARSHIP RANKING, 1996

On March 8, 1996, the Gorgas Scholarship Foundation, Inc. announced the ranking of the finalists in the 1996 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at Tuskegee University in Tuskegee, Alabama.

The winner of the first-place tuition grant of \$2500 was

Anna Marie Simpson, 1647 Jones Road, Springville, AL 35146.
Alabama School of Fine Arts. Michael Froning - Teacher.

First alternate and winner of a \$1500 tuition grant was

James Michael Jeffers, Route 1, Box 884, Ramer, AL 36069.
Sidney Lanier High School. Karen G. Carmichael - Teacher.

Second alternate and winner of a \$1000 tuition grant was

Stephen H. Cooper, 109 Creekside Drive, Florence, AL 35630.
Bradshaw High School. Cynthia Tillery - Teacher.

Third alternate was

(S) Rita Mukerji, 5554 Thomas Jefferson Court, Mobile, AL 36693.
Alabama School of Math and Science. Peggy Wilkinson - Teacher.

Fourth alternate was

(S) Channika Shalini DeSilva, 1712-C Vestawood Court, Birmingham, AL 35216.
Vestavia Hills High School. Beth Walston - Teacher.

Fifth alternate was

Heather Michelle Childers, 512 Pearce Street, Florence, AL 35630.
Bradshaw High School. Cynthia Tillery - Teacher.

Sixth alternate was

Laura Kathleen Coston, 1842 Courtney Avenue, Florence, AL 35630.
Bradshaw High School. Cynthia Tillery - Teacher.

Seventh alternate was

Manu Bumb, 208 Westbury Lane, Florence, AL 35630.
Bradshaw High School. Cynthia Tillery - Teacher.

Gorgas Report

Eighth alternate was

Stephanie Rose White, 3450 Cloverdale Road, Apt. 24, Florence, AL 35633.
Bradshaw High School. Cynthia Tillery - Teacher.

Ninth alternate was

(S) Kyla Elizabeth Tew, 102 Victoria Drive, Enterprise, AL 36330.
Enterprise High School. Calvin W. Reed, Ed.D. - Teacher.

Unable to exhibit:

(S) Henry Clay Quillen, 4215 Glenwood Avenue, Birmingham, AL 35333.
Indian Springs School. Dr. Mac LaCasse - Teacher.

(S) Jeffrey Collier Lamarque, 2054 Baneberry Drive, Hoover, AL 35244.
Resource Learning Center. Dr. Trudy Anderson - Teacher.

The rankings were established by a panel of judges consisting of department heads, deans, and professors from many of the leading universities and industries in Alabama.

Winners and finalists in the Gorgas Contests receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Foundation is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the U.S. Army. The purposes of the Foundation are to promote interest in science and to aid in the education of promising students.

(S) = Semifinalist for 55th Westinghouse Science Talent Search.

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